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CO-OPERATIVE TELEPHONES.

THE small economy offered in the circular advocating "Co-operative Telephones," to which we referred on the 29th ult., has evidently induced a very large number of the commercial men of Manchester to entertain the scheme, and the promoters having received, it is stated, more than a thousand applications to join the new company, called a meeting, which was held on the 5th inst. This meeting, numerously attended, was presided over by Mr. A. D. Provand, M.P., one of the principal promoters, who entered more fully into the objects of the circular, but did not explain the details as to cost of construction and maintenance, to which we specifically referred; but these were to be submitted to a committee which it was proposed to appoint at that meeting. We may mention that a committee of seven was appointed, and we presume we shall shortly learn the result of its investigations. It is proposed to use the "Bell" telephone both as receiver and transmitter, and those who are used to the working of a telephone can well understand the difficulties due to cross talk, &c., so well pointed out in a letter from the "Stanhope Company, Limited," in our last week's issue. To use the Bell telephone with any degree of certainty and comfort, not only should duplicate instruments be provided (one for receiving and another for transmitting), but also duplicate lines, *i.e.*, a metallic circuit, and this would naturally alter the prepared estimate. The chairman stated that any quantity of these instruments could be obtained from the telephone factory at Antwerp. "They could have a thousand machines delivered tomorrow if they could import them." "With regard to the transmitters used in Manchester, the patent for these would expire in 18 months or two years after the expiry of the patent for the receivers; but that was of no consequence whatever, for they could get plenty of transmitters." There are others, including the Stanhope Company, who think that will be a matter of some consequence. Other objections to which Mr. Provand's attention had been drawn were dismissed in a similarly airy and nonchalant way, notably, that of the "wayleaves," for the obtaining of which we are favoured with a deliciously new recipe. "Then about the roofs. The roofs were theirs. They were the tenants, and if they joined this society their landlords had got to do what they wanted them to do. There would be probably ten or twenty tenants in a Manchester warehouse. In such a case, the landlord would have to accommodate his tenants. He could not help it. (Hear, hear.) So there would be no difficulty about that." That is really quite refreshing; but how about damaged roofs, rain coming in, &c., and the many frequent repairs required, which usually have to be paid by the telephone company? We suppose these amiable Manchester landlords will smilingly do all that is required by his co-operative tenants. One point more. The Chairman occupied a very large portion of his time in giving a financial history of the various telephone companies, the late amalgamation, and everything necessary to show why they were compelled to charge so high a rental as £20 per annum; but nothing was said as to the equivalent in efficient service the subscribers got for that sum. Comparisons were made as to the cheapness of the telephone service abroad; but naturally as the comparison was unfavourable, all mention of the rentals charged in the United States was omitted.

The new "Co-operative Telephones" are, according to the Chairman, to enjoy their service for about £4 per annum, and receive interest or dividend at the rate of £5 per cent. on the capital. But who is to provide the capital? Of course, the subscriber! Consequently his rental must have added to it the interest on the cost of construction of his own line and the share of the cost of the central exchange, besides the risk of having to pay the share of any subscribers who cannot fulfil their engagements. Before any subscriber can enjoy the benefits of this "Co-operative" company he will have to pay the cost of the construction of his lines. This being an unfavourable point of view, has not been submitted. It is interesting, however, as it tends to bridge the two rentals.

THE Silvertown strike is over and the men have been fairly defeated. A correspondent of the *Times* who, on Tuesday, communicated the result of his visit to the headquarters of the Strike Committee, thus comments upon the struggle :—"The story of the Silvertown strike is emphatically a story of failure ; the men are, beyond question, beaten, and there does not seem to be any real cause for regret that this consummation should have been reached. Their complaint was, and is, twofold. They say, in the first place, that their earnings were not sufficient to enable them to make both ends meet ; but, on their own showing, as it seemed to me, the fault lay, not so much in the minuteness of their wages as in the greatness of the sum which they were compelled to pay for houseroom. Their wages have been considerable, varying from 3½d. to 4¾d. per hour for a week of 59 hours—these figures are taken from the backs of their own relief cards—and they have been wages such as a country labourer would be proud to earn. But the sums they pay for rent are, for people in their position, simply enormous, seeing that they have varied, roughly speaking, between a third and a half of their weekly earnings. For the rest, they complain that they do not obtain an adequate share of the profits made by their employers. Upon this question I am not entitled to express an opinion. In an ideal state of society the labourer would, perhaps, share not only the profits, which he invariably remembers, but also the losses, which he occasionally forgets, made by his employer. In a society which is not ideal, but merely practical, the labourer takes as much as he can obtain, and sometimes asks for more. At Silvertown he has asked for more and has attempted to force it out of his employers, and the result has been that he has failed." It seems to us that the *Times* correspondent has not quite grasped the question of house rent, for when, as at Silvertown, there are numerous branches of the same family all living at home and earning fair wages, the burden becomes comparatively light, so it is certain that the hardship, of which the workpeople complain, does not bear upon every householder with like severity.

IT is, of course, very right that the lesson which the strikers are now learning should be a salutary one ; but the pill which many must swallow this Christmastide is too bitter. The numbers who stand no immediate chance of re-employment we cannot estimate, but they must be considerable ; and this prospect for them to face, in addition to the losses of three months, will require something more than human endurance. That period of the year when peace on earth and goodwill towards men is preached, is just upon us, and is it too much to hope that now the bitter fight is ended, even the opponents of the unfortunate strikers will yield to the better feelings which the gay and festive season is said to prompt, and make their victory still more glorious by holding out a helping hand to the fallen. How gay and festive Christmas will be for the little colony of Silvertown can best be foreseen by those who have followed the course of events ; but be it remembered that in this unhappy struggle the men, or at least the majority, have been more sinned against than sinning. That their mistake in obeying the commands of agitators who have nothing in common with the British workmen and who are only using them as tools to further their own political ends, was of a grave nature, nobody knows now better than the men themselves, but their misdeeds have met with ample punishment. The victors can well afford to be generous, and we know the directorate of the company too well to think that there will be any high-handed treatment of their repentant workpeople.

PERHAPS the most unfortunate circumstances with which the employers of labour have to contend are the irresponsible public utterances of good Christian gentlemen, clergymen principally, who without the slightest knowledge of the business arrangements which exist between masters and men, throw themselves heart and soul into the dispute and invariably on the wrong side. A glance at the correspondence between the Secretary of the Silvertown Company and the Rev. Stopford A. Brooke will reveal a state of mind on the part of the reverend gentleman hardly befitting a Christian and a minister of the Gospel. Not contented with making a number of charges against the directors of the India-Rubber and Gutta-Percha Company, all of which were absolutely untrue, he insinuates that he does not see why he should accept the denial of his statements by persons directly concerned in the matters under discussion ; and yet, forsooth, he deliberately made his own charges from the pulpit on the strength of what some of the company's *former* workpeople intimated to friends of his on whose capacity and judgment he thought he had every reason to rely.

THERE was a time when we thought that the Rev. Stopford A. Brooke was the ideal of a minister and a man of the broadest and most charitable views, but a perusal of the letters in the *Times* of Wednesday, to which we have referred, will show how much one may be mistaken even in one's ideal, and it is a curious commentary upon human nature, how a man born for greatness may so be-little himself.

THE first balance-sheet of the Gülcher (new) Electric Light and Power Company is to hand, and, we must say, does not look very roseate ; although, perhaps, much should not be expected in the first ten months of working. On the credit side plant and stock, &c., stand for £34,238 ; the debtors and bills receivable, £2,054 ; cash in hand, £56. The debit side shows capital issued and debentures, £29,103 ; bills payable, £2,375 ; creditors, £3,675 ; National Provincial Bank, £789. A balance is shown thus (on paper) of about £405 to the good ; but this, of course, depends for its worth wholly on the value realised for the stock, &c. We sincerely hope, for the future of the company, that this has not been overestimated.

IN our issue of November 8th we mentioned that Crompton and Company, Limited, were proposing to issue first mortgage debentures ; another circular is now being sent round with the annexed—"Notice to shareholders" :—"The attention of members is drawn to the fact that, in the annexed prospectus, it is provided that the bonds shall be paid off at the end of ten years at a premium of £5 per cent. instead of at par, as stated in the circular of the 5th November, 1889." Such a statement, after a lapse of five weeks, leads one to the only conclusion possible—the first bait was not sufficiently attractive. The company had better call up the balances due on its preference shares before offering to mortgage its property by the issue of mortgage debentures.

AMONG the many points urged in favour of the electric light over gas for the illumination of mills there are several which owners are not often disposed to acknowledge, one being the very large amount of time saved in the one operation over the other. While the turning of a switch is sufficient to light up a floor, the gas attendant has to proceed with a naked light from burner to burner, turning the taps on, and then lighting the gas. This operation is invariably attended with much danger from the rapidity with which the "fly" or fluff is ignited by a spark. Although numerous instances of fire are due to this cause, it is difficult to bring them home, and millowners are, as we said, hard to convince. A fire occurred last week at a cotton mill in Bury, Lancashire, which was admittedly occasioned by the cause we have mentioned. "A man was carrying a lamp for the purpose of lighting the gas, when he stumbled as he was going up the steps. The lamp dropped on the floor and set fire to the fluff or waste cotton. The mill was speedily in flames. The damage is covered by insurance." The last paragraph may account for a good deal, but it will not pay for the loss of time in consequence of the work being stopped and the necessity of re-construction.

THE inconvenience caused by the gasworkers' strike in Manchester has not only resulted in the loss of light where the latter has been derived from the direct combustion of the gas, but also from the stoppage of electric light installations, where the latter have been worked from gas engines. Although the inconvenience is likely to be of but a temporary character, inasmuch as matters must eventually be adjusted by one or other of the parties in the dispute giving way, yet it seems possible that one result of what has happened may be to give an impetus to the use of petroleum engines. The progress of the gas engine, like that of most other useful inventions, was slow for many years, and then rapid, and it is probable that the same will be the case with the petroleum engine; already fair advances are being made, and as improvements are effected, these advances will be accelerated, until the industry becomes a very flourishing one.

THE impending strike of the South Metropolitan gas *employés* suggests the thought that had the supply pipes to the street lamps been detached from the mains which carry the gas for domestic lighting the masters could have made light of the intended turn-out of their men. We do not know whether this suggestion has ever occurred to the gas suppliers, but probably it would now be impossible or impolitic to adopt it; it may not, however, be lost upon electricity supply companies, who possibly in the future will be placed in a similar awkward predicament. Householders would willingly incur a little inconvenience during a strike epidemic, and for the nonce look after themselves; but the public lighting must not be allowed to suffer. Considering that the gas supply for the street lamps is only something like one per cent. of the general consumption it would be an easy matter to keep enough gas in hand for this purpose, even with a disorganised staff. Probably, however, if private consumers will be sufficiently economical the South London streets will not, after all, be left in darkness, as has recently been the fate of some of the Manchester thoroughfares.

ANOTHER death from electric shocks in New York. So said a telegram in the newspapers of Tuesday, giving also a brief description of the poor lineman's last moments, which were similar to those of that other victim, Feeks, whose fate was too horrible to recapitulate. The recurrence of these sad fatalities is making itself felt amongst us, for Firemaster Paterson, of Glasgow, laid before the Public Board on Monday a communication, drawing attention to some of the dangers attending the extension of overhead electric light wires in that city, and pointing out that his men run exceptional risks in this respect, having often to work on roofs in the middle of the night, amidst darkness, which hides the very perils that fire and falling walls may bring upon them. He states that he maintained silence so long as he believed that the suspension in mid-air of these electric light wires was a temporary arrangement, which would ultimately give way to an underground system; but seeing that cables are being run up over so many blocks in the centre of the city, he thinks the time has come when it is his duty to speak out.

PROF. JAMIESON curiously enough gave a lecture on the same evening to the Insurance and Actuarial Society of his town on "Fire risks due to defective installations of electric lighting, &c." During the discussion Firemaster Paterson asked the experts present how his men could best guard themselves during fires against dangers arising from contact with high tension wires, and it must have been consoling to that gentleman to learn that the risks were really very slight. Let us hope that the opinion of the Glasgow electrical engineers may not be rudely upset, for the danger is present here as in New York; our immunity from such scenes as have shocked civilised society in the States lies in the fact that our alternating current plants and high tension overhead wires are at present but few and far between, and also that we take greater precautions in the selection of our *matèriel*, than do our reckless American cousins.

AN important point in connection with submarine telegraphy is the question of the gutta-percha supply; we believe that competent authorities are agreed that another five years will see a great scarcity of the material, and yet nothing whatever is done towards helping posterity by replanting. It is often said that there can be but little doubt that some material will eventually be found which will supersede gutta-percha, but it is certain that, up to the present, of all the wonderful and fearful compounds that have been invented, not one has proved to be of the slightest value as a substitute for gutta-percha in cable cores. It would almost seem as if India-rubber will again come forward, treacherous as it has proved to be in many cases; very much has been done, however, of late years to make it a more reliable substance, whilst the supply of it does not, we believe, threaten to run short.

THE Managing Director of W. T. Henley's Telegraph Works Company has written letters to the press taking to task Mr. W. Fowler, Chairman of the Fowler-Waring Cable Company, for making a statement at that company's statutory meeting which might be taken to imply that the late Mr. Henley gave up the manufacture of cables after vacating his old works, a portion of which is now occupied by the Fowler-Waring Company. Perhaps since Mr. Henley's death the North Woolwich firm has never been so pressed with work as at the present time.

REPORT ON THE APPLICATIONS OF ELECTRICITY TO RAILWAYS.

By MM. E. SARTIAUX and Z. WEISSENBRUCH.

(*Concluded from page 634.*)

Second Part.—The Electric Lighting of Stations.

1.—Uncovered Stations.—Latterly, the management of railways has generally made a point of improving the lighting of open yards, where numerous lines are provided for separating or making up trains, or for loading and unloading trucks.

The great advantages resulting from the introduction of an intense light in such stations are generally admitted. A light as intense as daylight is found desirable on the grounds of safety, economy, and speed. Electricity alone can furnish lights of sufficient power under economical conditions.

The "lucigen" lamps have been proposed as an economical substitute for electricity. These lamps burn heavy oils of coal tar, pulverised by means of a pump for compressing the air, worked by steam. But these lamps cannot work without much noise and smoke, and a very sooty, unsteady flame. M. Déry thinks that these lamps may be used for temporary occasions, such as moving or landing troops.

According to the Dutch State Railway managers the lucigen lamps are not economical. The substitution of a lucigen lamp by two electric burners of equal power effected an economy of 67 per cent.

II.—*Covered Stations and Sheds.*

Railway managers have generally recourse to arc lights for waiting rooms, platforms, and large refreshment rooms. But in offices and workshops, where each *employé* requires a special light, the glow lamp is necessary.

The electric light is the most perfect and the healthiest of all known artificial illuminants. It lights up a room without the eye perceiving directly the luminous focus, and can be made absolutely steady and uniform without irritating the retina. It does not poison the air with carbonic acid, carbonic oxide, or sulphuretted hydrogen, and it yields but very little heat. The gain in point of health among the *employés* at the central post-office at London is equal to two days yearly for each *employé*, or an economy equal to eight persons.

III.—*Movable Electric Lighting Installations.*

These installations are proposed on occasion of the movements of large bodies of troops in time of war, for effecting rapid repairs in case of accidents, and for excursion trains, which sometimes bring large numbers of passengers to stations which are generally little frequented. Various devices are here figured, and show that such an installation is easily effected.

IV.—*Electric Lighting of Signals on the Line.*

This question has not yet gone beyond the experimental stage. One of the most important trials of which we have heard has been undertaken by Mr. W. W. Slater, chief of the signal service of the Southern Pacific Line (United States) at Oaklands Station. At this station there is a fairly important installation for electric lighting on the Brush system. Mr. Slater had the idea of adding glow lamps to light up the signals. One of the most serious difficulties to be avoided was the sudden extinction of a signal produced by the rupture of the filament in the lamp. To prevent this Mr. Slater, in the first place, set about increasing the duration of the lamps. To this end he reduced the intensity of the current to 1·2—0·8 ampère, and consequently he brought the luminous intensity of the Swan lamps which he employed from 16 to 10 candles. These trials commenced on May 30th, 1887, proved that the duration of a filament could be prolonged to a minimum of 2,599 hours, *i.e.*, more than a year, and this without a current regulator. For ordinary signals he appropriated the lanterns of the oil lamps, putting a block of wood as a support. Flexible wires led the current to the base of the lantern.

For the semaphores he constructed a special air-tight lantern, 18·4 centimetres wide, 7½ in depth, and 21·3 centimetres in height. The bottom was formed of a piece of wood kept in its place by hinges and a pressure screw.

He estimates that he has effected an important economy by the use of electricity. According to him the oil lamps cost each, per month, 3·34 francs for oil and labour, and 1·30 francs for the sinking fund. The electric lamps cost only 1·56 francs, not including the sinking fund. In addition to the economy the electric lamps present great advantages. According to Mr. Slater the electric signals are always clearly visible, and it is sufficient to clear the lamps from time to time at the outside only, whilst the oil lamps rapidly soil the interior of the lanterns by the dust which they admit and the smoke which they produce.

The Northern of France attempts to solve the problem in another manner, rendering the replacement of the signal lamps automatic, and giving to each group a separate source of electricity.

In the first trials were employed lamps of 3 ampères at 10 volts (10 candles), fed by six accumulator elements of the company for electro-metallurgy. Two lamps were placed, one above the other, in the existing lanterns, the upper one being directed downwards and the lower one upwards, so that each had a part of its filament placed in the focus of the reflector. The current traversed an electro-magnet of low resistance, the keeper of which being attracted, brought the upper lamp into circuit. If this happened to be suddenly extinguished, the keeper, becoming detached, let the current pass into the lower lamp. In new experiments the apparatus is completed by an alarm bell destined to call attention if the second lamp gets out of condition.

When a station is already provided with the electric light the supplementary outlay is very slight. On the other hand, as a great part of the signals in their normal position indicate that the track is clear, it is often sufficient to pass the current only when giving the signal to stop. It is calculated that for one annex at the La Chapelle stations more than 10,000 francs may be saved yearly, whilst giving all the time a better light.

V.—*The Working Cost.*

The Congress had decided at Milan that the electric light in a certain number of cases might give economical results, but that the installations being too recent for an appreciation of the working cost, it would be useful to postpone the examination of the question to the next session.

Although the time which has since elapsed is very short, the electric light has made such rapid progress, and has been so much developed that experience, far from weakening the favourable forecasts which the existing state of the question permitted, has, on the contrary, proved their accuracy.

The cost of the installation, which was heavily burdened by the items for interest and replacement, has been decidedly eased by the decrease of the cost price of arc lamps and dynamos, the yield of which has continually increased.

As for the expenses of working, properly so-called, they have also experienced heavy reductions, on the one hand, by a fall in the price of carbons for arc lamps and of glow lamps, combined with an improvement in their durability. On the other hand, the staff is more usefully employed in consequence of increased experience and of better arrangements in the installation.

We must add to the economies already mentioned that which results from the diminished outlay for purchasing and maintaining accumulators, which have been rendered more substantial and more durable, also from the experience which has been acquired for some years in the construction of electrical machines, the simplicity and solidity of which have reduced the cost of maintenance to a minimum.

It may appear that the difference between the price of electric lighting and that of lighting by other systems is still so great that the considerable advantages of the former do not justify its exclusive use, if, for instance, the durability of the lamps is low or the price of other methods of lighting is exceptionally reduced. But in a number of cases the direct advantage of economy is now added to the excellence of the electric light.

1. *Comparison of Different Projects for Lighting a Station.*

The question of the comparison of the different projects for lighting a station has been recently raised before the Belgian Society of Electricians by M. Ernest Gérard. This question seems so much the more difficult to solve, as it is almost impossible to establish a complete parallel between the method of lighting prevalent in one station and that which exists in another. Account must be taken of such a great number of elements of different natures that it is impossible to bring them all under one simple formula.

We have the intensity, the steadiness, and the colour of the light, the pre-existence of a gasworks or of a central electrical station, the price of gas, or of motive power, the number of hours of lighting, the possibility of raising the foci and of using them with uncovered burners, &c.

It is to be remarked that not only the comparative calculations as reached in any particular case cannot be generalised, but that they most frequently give no determination of the quantity of light obtained by means of each of the methods of lighting considered.

The illumination of the different objects submitted to the effects of a source of light varies so much from one point to another that a few operations of direct measurement do not suffice to give any idea of it. The eye is deceived; it accustoms itself so well to an increase of artificial light in many streets and public places where the old burners have been discarded in favour of "intense" jets of five or six times the power, that many people did not notice the change. The administration of the Belgian State Railways has sanctioned the choice of a system of lighting, whether by gas or electricity. The system is based as follows:—

The minimum quantity of light to be furnished is to be $\frac{1}{n}$ (generally $\frac{1}{50}$th carcel in open spaces), at any given point.

The illumination is not measured directly, but calculated on the supposition that, the burners being of equal intensity, the minimum corresponds to a point situate at equal distances from two successive burners. It is then sufficient if one of the burners gives at this point $\frac{1}{100}$th carcel, to have in all $\frac{2}{100} = \frac{1}{50}$. The illumination, e, at a point situate at a distance, Δ, from a burner of the intensity 1, is found by the formula:

$$\frac{e}{1} = \frac{1}{\Delta^2}; \text{ whence } e = \frac{1}{h^2 + l^2}.$$

2. The intensity 1 which figures in the preceding formula is the mean spherical intensity.

In the commonest case for open spaces, that of arc lights fed by continuous currents, it is equal to half the horizontal intensity *plus* the fourth of the intensity taken at an angle of 45°, and considered as the maximum according to the formula $I = \frac{1}{2} H + \frac{1}{4} M$. The results obtained were very variable, but gas was almost everywhere successful, at Antwerp, at Arlon, and at Schaerbeek (South).

The award has been favourable to electricity only at Montigny. Yet it appears that this latter station, and that of Schaerbeek (North), which is also electrically lighted approximately on the same system, have much more light than those where gas has carried the day. Herr Dery declared at Milan that the chief motive of the system tried by the Belgian States was economy.

The Question of Electric Brakes.

The authors do not attempt to give a history of electric brakes, a summary description of which will be found in the report on the applications of electricity at the Session of the Railway Congress of 1885. We will merely mention the new systems taken from the patent lists, which have been made the subject of experiments or studies, the results of which we have been able to obtain.

This survey is divided into two parts: the first relating to brakes, purely electrical, and the second to the aëro-electric brakes.

Under the first head they describe and figure the Achard brake, to which was awarded the Monthyon prize in 1865, the Park brake, the Card brake, tried on the carriages of the Cincinnati, Hamilton and Dayton Railway, the Waldumer brake, and the Widdifield and Bowman. The aëro-electric brakes are the Westinghouse, the Eames, and the Carpenter.

Lastly come the direct action brakes, the Sawiczeski, the Siemens and Bootly, which has been tried in Scotland with encouraging results, and the Marcel-Deprez.

It appears that since the last session of the Congress electric brakes have not undergone any decisive improvements, though the present state of research permits us to hope for more perfect results at an early date.

The Congress thinks it will be interesting to improve the existing electric brakes, and to set on foot new researches in the direction of the direct transmission of power.

Exposition of the Question of Electric Soldering.

It has long been known that the voltaic arc possesses an extremely high temperature, and that it effects the fusion of the most refractory metals. The idea of employing the heat of the arc to effect the direct (autogenous) soldering of sparingly fusible metals—such as cast-iron, steel, brass, bronze, nickel silver, &c.—is not novel, but the earlier inventors failed on account of the difficulty of regulating the effect produced. They only succeeded in melting holes in the pieces of metal, or in burning them.

At present two inventors, M. de Bernardos and Mr. Elihu Thomson, alone have arrived at a combination of apparatus for effecting electric soldering; other experimentalists do not seem to have reached the practical stage. Their principles are very similar, though we might say that the Bernardos process is to that of Thomson like the arc light to the glow light.

M. de Bernardos employs the heat of the arc to fuse metal into the interstices of the parts to be connected. To this end he attaches the negative pole of the source of electricity to the metals to be joined, and connects the positive pole to a carbon rod fixed on an insulated support. Experiment has proved that the poles cannot be inverted.

Thomson passes the current through the two objects to be united, compressing them together. The heat developed by the resistance of the joint is sufficient to soften and solder the metals. The effect of incandescence increases spontaneously as soon as the first heating is effected, the resistance of the metal is greater when hot than cold.

We see that the second process is especially suitable for uniting pieces of metal end to end, if they are not too thick.

It will be seen that the only procedures for the electrical working of metals which have arrived at a certain development are still in the experimental stage. The method of Thomson is little applicable to railways; that of Bernardos has more numerous applications, but which still require improvements.

The question is accordingly placed on the order of the day for the next Congress.

THE ARREST OF GROWTH IN CANCER BY THE INTERRUPTED VOLTAIC CURRENT.*

By J. INGLIS PARSONS, M.D. (Assistant Physician to the Chelsea Hospital for Women).

THE method of treatment about to be described is based upon the following considerations: First, with regard to the nature of cancer. The earliest pathologists regarded it as a dyscrasia, or altered constitution of the blood; then followed the embryonic cell theory; finally, the microbe was made to bear the burden of further misdeeds. Virchow, with his dogma, "*Omnis cellula e cellulâ*," demolished the first. The second, propounded chiefly by Cohnheim, will not account for all tumours, even if it be admitted as possible that embryonic tissue can remain for a quarter to half a century in the human tissues without partaking in the changes undergone by other cells in the body. Thirdly, all attempts to find the microbe have failed. The hypothesis now brought forward is founded on the fact that all the cells of the body possess a latent capacity which enables them, under various stimuli, to proliferate and form new tissue. Under normal conditions, this capacity remains dormant, or is only exercised to the extent of keeping pre-existing structures in a living condition. But let an injury or irritation to some part of the body occur, and this latent capacity ceases to be dormant, and an active formation of cells takes place, until the injury is repaired or the irritation removed. Now this formation of new tissue is essentially a new growth, although not a tumour. The capacity for forming it is common to all the tissues of the body, and it ceases when the necessity for its continuance has disappeared. This appears to show some controlling influence, probably by the nervous system. Is it not, then, possible that all tumours are in the first instance composed of cells formed in the normal process of repair, but that, having escaped from the control of the nervous system, they take an independent life, and continue to proliferate and develop without check, just as all living cells are capable of doing *ad infinitum* under favourable conditions?

The frequent association of cancer with a depressed condition of the nervous system is explained by this hypothesis. In other words, a tumour consists of cells which have sprung from the pre-existing cells of the body, but have escaped from the control of the system at large. The close connection between the two is shown by some statistics in a recent paper by Dr. Gross,† who found that out of some 907 cases of cancer of the breast there had been antecedent inflammation in 20 per cent., and a history of injury in 13 per cent. Dr. John Williams found microscopical evidence of the gradual transition from healthy tissue into cancer in a case described by him in the Harveian Lectures.‡ At the same time, although devoid of nerves, all tumours have some sort of vascular arrangement, and continue to receive nourishment from the circulation. In this respect they are on an equal footing with the rest of the body. There is one point, however, in which the normal cells of the body essentially differ from tumour cells. Most of the latter show a decided tendency to degenerate, while, in marked contrast to this, the healthy tissues possess wonderful recuperative powers, due probably to the presence of trophic nerves. It therefore seemed to me that if a cure were to be found for cancer, it would be based upon this essential difference between healthy tissue and tumours, and that on account of this difference some agent might be found capable of inflicting an irreparable damage to a tumour, and yet stop short of destroying the normal cells of the body, on account of the higher recuperative powers possessed by the latter. And further that, although the normal cells of the body are unable to resist the invasion of the cancer cells, the latter are actually of lower vitality. If such be the case, it may be asked why should the cancer cells devour the healthy? The probability is that the difference in composition and structure between the malignant and healthy cells is not sufficient to stimulate the latter to resistance. Consequently, the proliferation of the cancer cells, resulting from their independent existence, enables them to overcome the healthy cells, since these, for want of sufficient stimulus, remain passive. In a paper read before the British Gynæcological Society in 1888, on "The Action of the Constant Current on Fibroid Tumours of the Uterus," I advanced the hypothesis: "that while the normal tissues of the body have the power of recuperating any effect produced on them by the transport of elements, the cells of tumours, being of lower vitality, might be checked in their growth, and perhaps in time destroyed."

The following experiments were tried in 1887 to ascertain whether, when a current is passed through a tumour, any decomposition takes place between the poles. Three glasses were connected together with a a stout lamp wick. Into each of these a standard solution of iodide of potash was placed. A current was then passed through the solution with an intensity of 200 milliampères until the whole of the iodide of potash in the two outer glasses was decomposed. On testing the centre glass, it was found to contain as much iodide of potash as before, although in the two outer glasses it was all decomposed. The resistance of this apparatus was so great that I was obliged to go to the Electric Apparatus Company and do the experiment in the vaults of the Junior United Service Club, where an unlimited supply of volts could be obtained. A second experiment was then tried with water in the outer glasses and a solution of iodide of potash in the centre. The current was passed as before, but no decomposition took place in the centre glass. A third experiment was tried on the web of the frog's foot, and watched through the microscope. At the positive pole a coagulation took place, with exudation of blood from the capillaries. At the negative pole a collection of hydrogen bubbles could be seen. Between the poles no change could be observed, and the circulation went on as before. Finally, a strong current was passed through a fibroid tumour, soon after removal from the body, for a period of several hours. On making sections of the portion between the poles, no change could be detected. All these experiments demonstrated in a conclusive way that the passage of a constant current does not cause any decomposition between the poles, although there must of necessity be an exchange of atoms between the molecules. Recently I have had an opportunity of examining sections of a fibroid tumour that I had thoroughly treated with a constant current, and which was subseqnently removed by Dr. Travers on account of its size. No change could be found between the poles, showing that the conclusions drawn from the previous experiments were correct. Subsequent experience has shown me that repeated applications of the constant current, with an intensity of 200 milliampères, are unable to control the increase of a quickly growing fibro-cystic tumour. But I noticed, in treating cases of fibro-myomata of the uterus by a constant current, that when, as occasionally happens through an imperfection of the circuit, the current was suddenly interrupted, marked signs of disturbance followed, such as rise of temperature, considerable pain, and malaise. Rightly or wrongly, I put this down to some destruction of tissue occurring in the tumour, and if this conclusion be correct, the means required for the treatment of cancer on the hypothesis advanced have been found. The most probable explanation of this phenomenon is that the impact of a powerful current when suddenly flashed through causes death to those tumour cells which lie in the nearest path between the poles where the lines of force are most concentrated, or else they are sufficiently injured to lead to their gradual atrophy. The latter explanation is more probably the true one, as no rise of temperature or other symptom follows the applications when applied to cancer.

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* Abstract of a paper read at the Surgical Section of the British Medical Association, August, 1889.

† Inter. Jour. of Medical Science, March and April, 1888.

‡ Ibid, 1886; Case 15, p. 51.

For the treatment of fibroid tumours anything likely to cause their wholesale destruction is to be deprecated. For this reason interruptions of the constant current have been carefully avoided, and precautions taken to gradually increase it as smoothly as possible. Being surrounded by a capsule, and having but few vessels in their interior, a gangrene *en masse* might follow, with all its attendant consequences. But this argument would not apply to cancer. Those cells especially that most require to be destroyed are scattered through the healthy tissues, and each little islet or bird's nest is surrounded by this tissue, furnished with vessels and lymphatics capable of absorbing it so soon as loss of vitality and degeneration occur. I therefore felt no hesitation in trying the destructive effects of a powerful interrupted voltaic current in the first case of cancer that objected to be operated upon in the usual way. After waiting a year or more the case presented itself. There is one point that, for want of space, I have not entered upon: Is cancer a local or a general disease? So far the accumulation of evidence appears strongly in favour of its being, at any rate, a local disease at first.

The *modus operandi* is as follows:—The patient is anæsthetised; the current is then passed through the tumour and all the tissues for some inches round it by means of fine insulated needles, so as not to injure the skin. A battery of 70 cells, with an electromotive force of 105 volts, is used; the intensity of the current to commence with is 10 milliampères, gradually increased to 600 milliampères, and flashed through the growth in every direction from 50 to 100 times, according to circumstances. The pulse and respiration are carefully watched. One out of the four cases treated (a woman aged 63, with extensive carcinoma of the left breast, a presystolic bruit, and weak intermittent pulse) was unable to stand more than 250 milliampères, and for this reason: when the current is applied to the left breast electrical stimulation of the heart occurs, and if this organ is healthy an increase in the strength of its contraction appears to take place after its passage; but with the patient who had cardiac disease the improvement only continued up to a certain point, and then the intermittency increased and great irregularity occurred.

These observations, made last year on the human subject, corroborate exactly those made in the laboratory on mammals by Dr. John McWilliam. He called the condition of the heart fibrillar contraction—that is to say, a widely incoördinated arhythmic contraction of the ventricular muscle, attended by a great and rapid fall of blood pressure. It is only, however, in the immediate neighbourhood of the heart, and when it is diseased, that this takes place. When the current was passed through a secondary growth in the axilla of the same patient, it could be increased to 600 milliampères with perfect safety.

The effects produced by the action of the electricity consist in a cessation of growth, gradual disappearance of pain, some shrinking and hardening of the tumour, and enlarged glands, followed by improved nutrition and a better state of the general health. The growth as a whole does not disappear, but remains as an inert mass, composed in all probability of fibrous tissue alone. Before treating these cases I felt almost sure that this would be the case, because I had found by a number of experiments, detailed in the paper before referred to, and also from treating a large pelvic fibroma by galvano-puncture in 1887, that neither could electricity decompose the fibrous tissue of new growths (whatever it might do with cicatricial tissue), nor could the system cause its absorption after it had been rendered inert. However, it will always be open to patients to have the remains removed with the knife if necessary.

The advantages claimed for this method of treatment are as follows: 1. There is no destruction to the normal tissues of the body, and if recurrence should at any time occur, its progress can be immediately stopped, and the treatment repeated as many times as necessary. Life would by this means be prolonged indefinitely, provided that metastatic deposits had not occurred before the commencement of the treatment. 2. Patients are not obliged to lie up for more than a day or two as a rule. They lose no blood, and are not generally any weaker. 3. The current can be passed through almost any part of the body, and thus arrest growths which could not by any possibility be otherwise treated.

PRODUCTION OF MOTIVE POWER FROM ELECTRICITY.

[FROM A PARISIAN CORRESPONDENT.]

Mr. Jablochkoff recently read an interesting paper before the Société des Ingénieurs Civils on the subject of the production of motive power from electricity. Mr. Jablochkoff has long been an advocate of galvanic electricity, and although chemical reactions were the first means of obtaining electricity he does not consider it a retrograde movement to return to this mode of production, but, on the contrary, as a step in advance. He considers that the production of electricity from motive power has been a palliative; a happy one, but only a palliative. The lecturer went on to say that the real production of electricity has its source in chemical means. In dynamo machines the initial power is due to the combustion of fuel, which is a chemical combination, but the utilisation of which, in a good engine, does not exceed 10 per cent. Whereas only 10 per cent. of the theoretical efficiency is obtained in the shape of power, as much as 90 and even 100 per cent. electrical calories can be obtained under favourable conditions in electro-chemical combinations. It is true that, in the latter case, the fuel used, which are metals such as zinc, sodium, cast-iron, are dearer than the fuel consumed in steam engines, but the efficiency is at once 90 per cent., which affords a large compensation for the discrepancy. If, for instance, we consider the case of cast-iron, a useful horse-power hour will consume 750 grammes, and the said consumption may be brought down to 500 and even 400 grammes. As cast-iron costs 40 francs per ton the expenditure per horse-power hour will amount to 3 centimes (a little over a farthing). If to this is added the cost of the sulphuric or hydrochloric acid necessary to oxidise the metal, or about 1 kilogramme of acid per kilogramme of cast iron, the cost of the useful horse-power hour amounts to 9 to 12 centimes, which cost is about equal to that of the production of electricity by means of dynamos driven by engines of 15 to 25 horse-power.

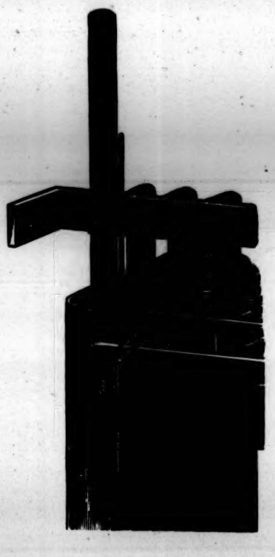
Moreover, when powerful engines are used for the production of electricity, shafting and belting have to be used, and the stoppage of a number of dynamos does not result in a corresponding reduction of the motive power expended. When electricity is used as motive power there is scarcely, according to the lecturer, any advantage in substituting the power obtained from dynamos to that deriving directly from the steam engine; but the same does not apply in the case of the current being produced by chemical means; this he attempts to demonstrate experimentally, when the figures he uses give rise to objections.

The upshot of Mr. Jablochkoff's lecture is the utilisation of local currents and polarisation in batteries, instead of their elimination. To this effect he uses a three-electrode battery, one being a metal capable of being consumed, the other an unoxidisable metal, such as platinum, and the third a porous carbon. On closing the circuit of the two-metal electrodes a powerful polarisation is obtained which soon stops the chemical action. When the couple thus formed, and the third electrode are joined, a powerful current will be developed, so that the two first electrodes act as an accumulator, and the three together as a battery. When the battery is at rest it stores electrical energy, and the battery does not consume in open circuit.

A discussion is shortly to take place on Mr. Jablochkoff's paper.

THE HOLDEN HYDROMETER.

A NEW type of hydrometer, which is giving great satisfaction, is due to Captain Holden, and is specially designed for use in secondary batteries. Many of our readers must have found the difficulty of reading the specific gravity of the acid with an ordinary hydrometer, both from the difficulty of seeing the exact point to which the instrument has sunk in the liquid, and also from the closeness of the divisions on the scale, rendered necessary by the small rise and fall for important differences in specific gravity. With the new form the hydrometer is made of vulcanite, and is not itself marked at all, but rises and falls alongside a fixed vulcanite scale, upon which the numbers and lines are shown in white, and a range of five or six inches is thus obtainable in place of the usual half-inch. The scale itself can be held by India-rubber bands, or other similar means, to the cross bar from the ends of the plates. The apparatus is supplied by Messrs. Drake and Gorham, and is illustrated below.



SOME INTERESTING FIGURES RELATING TO THE COST OF THE ELECTRIC LIGHT.*

ENGINEER COMMISSIONER RAYMOND, of Washington, D. C., acting under the direction of an act of Congress passed at the last session, has been making long and careful investigations to determine whether any reduction can be made in the prices paid for public lighting, either by electricity or gas, on annual or five year contracts. The city is now paying the gas company $20 per year for each six foot burner for 2,600 hours illumination, and the United States Electric Company 60 cents for each arc light of 1,000 actual (2,000 nominal) candle-power, burning all night (about 11·74 hours), which is equivalent to $219 per light per year. There are 181 arc lamps in use, all on underground conductors, carrying a high tension current of about 2,500 volts. Both of these corporations are armed and equipped for determined opposition to all attempts to invade the position held by them. The gas company declines to make any reduction on one year contracts, but would take a five year contract at $19.50. President Norment, of the United States Company, informs Major Raymond that they have built an extensive system of most substantial conduits at great expense; are using the best lead-covered cables and have been subjected to a heavy outlay in renewing burnt-out cables, but they regard this work as experimental, and believe that time can only determine whether the system will be successful. It has been in use too short a time to decide whether it can be maintained upon a basis of 60 cents per lamp. Mr. Norment declares that electric lighting is still in its infancy, that it is impossible to form any adequate idea of its actual cost, and that any reduction in the present price would be unwarranted.

Major Raymond has endeavoured to ascertain what the proper price should be in two ways: first, by comparison of prices paid in other places, and second, by a theoretical estimate of the cost of production in this city. He has prepared a statement of the prices in 336 localities, from which it appears that the lowest price is $33 per light per year, burning to 12.30 a.m., and the highest is $280 for all-night lights; the average price for all and every night lights is 38·6 cents per night per light. From this data he concludes that the minimum price which can be justly paid for the underground arc light system is about 57·6 cents per night per light.

The following are the "all-night" prices at some of the principal places in the statement referred to:—

CONTRACT PRICE FOR MUNICIPAL ARC LIGHTS, 2,000 CANDLE-POWER.

Place.	Term of Contract.	Number of Lights.	Price per Light per year.
New Haven, Conn.	3 yrs.	146	$171 55
Wilmingion, Del.	3 „	33	164 25
Tampa, Fla	20 „	20	182 50
Atlanta, Ga.	3 „	150	120 00
Columbus, Ga.	3 „	40	108 00
Savannah	...	100	255 00
Texarkana, Ark.	30 „	14	160 00
Pueblo, Col.	5 „	100	156 00
Trinidad, Col.	5 „	30	150 00
Indianapolis, Ind.	2 „	100	60 00
Leavenworth, Kan.	...	35	120 00
Louisville, Ky.	1 „	50	233 60
New Orleans, La.	4 „	948	130 00
Lowell, Mass.	...	182	182 50
Fall River, Mass.	...	40	180 00
Salem, Mass.	3 „	170	163 50
Springfield, Mass.	1 „	54	20 00
Worcester, Mass.	3 „	170	200 00
Adrian, Mich.	3 „	63	100 00
Albion, Mich.	1 „	33	135 00
Battle Creek, Mich.	...	65	200 00
Detroit, Mich.	3 „	673	178 85
East Saginaw, Mich.	3 „	126	120 00
Grand Rapids, Mich.	1 „	40	140 00
Jackson, Mich.	...	194	88 81
St. Cloud, Minn.	1 „	24	125 00
Natchez, Miss.	5 „	65	85 00
Kansas City, Mo.	...	65	200 75
Nevada, Mo.	20 „	16	125 00
Sedalia, Mo.	3 „	20	125 00
St. Louis, Mo.	...	2,250	75 00
Manchester, N. H.	3 „	240	142 35
Camden, N. J.	5 „	119	146 00
Salem, N. J.	1 „	32	80 00
Trenton, N. J.	1 „	106	182 50
Albany, N. Y.	6 „	481	182 50
Brooklyn, N. Y.	1 „	1,106	182 50
New York City, N. Y.	1 „	1,324	127 75
Poughkeepsie, N. Y.	1 „	210	123 00
Rochester, N. Y.	5 „	1,050	104 03
Syracuse, N. Y.	3 „	295	144 00
Carson City, Nev.	...	10	300 00
Dayton, Ohio	10 „	146	150 00
Springfield, Ohio	1 „	54	130 00
Steubenville, Ohio	5 „	23	75 00
Toledo, Ohio	5 „	400	100 00
Altoona, Pa.	1 „	32	98 00
Harrisburg, Pa.	1 „	240	90 00
Lancaster, Pa.	3 „	138	124 00
Pittsburgh, Pa.	3 „	500	104 00
Providence, R. I.	...	247	182 50
Nashville, Tenn.	3 „	150	82 77
Rutland, Vt.	5 „	56	280 00
Ellensburg, Wash.	50 „	7	180 00
Milwaukee, Wis.	3 „	135	150 00
Montreal, Que.	5 „	135	146 00

Not being satisfied that the experience in other localities is of any great value in ascertaining the cost of lighting in this city, and having no power to require the local company to furnish information, Major Raymond, in order to arrive at a more reliable result, has prepared the following estimate of the cost of such a plant as is now operated by the United States Company at Washington, with a capacity for 350 arc lamps (1,000 actual C.P.), and 4,000 incandescent lamps (16 C.P.) :—

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* New York *Electrical Review.*

Cost of Station and Plant.

Land	$20,000
Buildings	20,000
12·4 miles conduit ($11,000 per mile)	136,400
Lamp posts and heads	4,500
Office and storeroom fittings	1,000
Boilers, engines, dynamos, &c.	126,000
16 miles arc light cables ($1,000 per mile)	16,000
2·56 miles incandescent light cables ($1,900 per mile)	4,864
2·24 miles incandescent light cables ($4,070 per mile)	9,117
	$337,881
Superintendence and labour per year	17,130
Coal, 3,988 tons (5 lbs. per H.P. hour), at $3·25 ...	12,961

Running Expenses.

Labour and salaries	$17,130
Maintenance	3,500
Taxes	532
Water...	600
Insurance	375
Coal	12,961
Oil, wate and sundries	2,549
	$37,647

Depreciation.

Buildings, &c.,	5 per cent.	... ...	$8,095
Machinery,	10 „	... ...	12,600
Cables,	15 „	... ...	4,497
			$25,192

Interest on capital, 6 per cent.	$20,400
Cost per horse-power hour	4·66 cents.
Cost of municipal arc lamp per annum, 4,286 hours at 4·66 cents per hour	$199 73
Carbons	15 40
	$215 13

Cost of arc lamp per night ... ... 58·94 cents.

LARGE INCANDESCENT LAMPS v. ARC LAMPS.

AT a meeting of the South Wales Institute of Engineers an interesting paper on the above subject was read on the 28th ult. by Mr. Sydney F. Walker, M.I.E.E. The author stated that when the glow lamp was first introduced by Mr. Swan two objections were raised against it by the partisans of arc lamps. The first was that the energy required to furnish a given standard of light, measured by the photometer, was about ten times as great when the current was employed to raise a carbon filament to a white heat as when used to vaporise carbon in the voltaic arc. The second objection was that the amount of light obtainable from a glow lamp was very small, so that it was very doubtful whether that form of lamp would have any effect upon the use of arc lamps, with the exception of extending electric lighting generally. As is well known, the 16 or 20 C.P. glow lamp was the largest obtainable for several years for practical work, and although many attempts were from time to time made to introduce 50 to 100 C.P. lamps, failure was, until about two years ago, the only result. This was due to their requiring a large current, giving a doubtful candle-power, and to their life being short. The arc lamp was then taking the lead, but at the Jubilee Exhibition in Newcastle in 1887 a glow lamp of from 100 C.P. upwards was shown. This was the Sunbeam, which began with a life of a few hundred hours and of low candle-power ; but since that time both the life and the amount of light have been considerably increased, until now it is not a question whether a certain space can be lighted entirely by incandescent lamps, but whether it is cheaper to use large glow or arc lamps. This question was the object of the paper. Sunbeam lamps are now made from 150 to 3,000 C.P., although very few of the latter are yet in use. After referring to the amount of current required by these lamps and those of the Edison-Swan type, the author considered the relative cost of working with an arc and glow lamp.

The initial cost of a glow lamp, say of 500 C.P., was about one-fifth that of an arc lamp taking the same quantity of current. The illuminating power of a large glow lamp might appear to be much less than that of an arc lamp for the same expenditure of energy. This is, however, in practice not so great as might be imagined. To prove this he said that the A type of Sunbeam lamp required only 2 watts per candle-power as compared with 3½ watts for the Edison-Swan lamp, the original proportion of 10 to 1 for illuminating power of arc lamps in proportion to that of glow lamps being reduced to less than 6 to 1. Then, again, a large portion of the light given by arc lamps is wasted ; they have frequently to be shaded, and whilst the rays can be seen at a great distance, the deep shadows cast on surrounding objects often render more lamps necessary than would otherwise be the case. In practice the ratio would only be as 2 to 1. To elucidate this he stated that if an arc lamp consuming 500 watts used in an open space were to be replaced by a Sunbeam lamp, one using 1,000 watts would be necessary ; but, for confined spaces, the author contended that the ratio would only be as 1 to 1, that is to say, the same current and the same voltage used in a Sunbeam lamp would give an equal quantity of light for practical purposes as an arc lamp. Of course the light from the former would not be seen at so great a distance as that of the latter, but in the immediate neighbourhood work can be carried on more satisfactorily owing to the glow lamp being steadier. With Edison-Swan lamps the ratio would, however, be as 3 or more to 1 for open spaces, and as 1½ to 1 for confined areas. Turning to the working cost, he took a standard arc lamp, using 500 watts, and found that the running expenses would be £4 2s. 6d. ; for a Sunbeam lamp, taking 500 watts for 1,000 hours, £1 15s. 6d. ; and for a 1,000-watt glow lamp, which would supplant a 500-watt arc lamp in open areas, the running expenses would be £3 7s. With the glow lamps no allowance was made in the above calculation for attendance, as none is required except when renewals are made ; and with the arc lamps no account was taken of waste carbons, repairs to lamps, &c. It will thus be seen that under favourable conditions, and allowing for attendance, the cost of the glow lamp in confined areas is less than half that of the arc lamp, and in open spaces about 20 per cent. less. The author, in conclusion, stated that for industrial work, at least, the large incandescent lamp is far superior to the arc lamp, especially if the plant is the property of the owners of the premises lighted.

SUBMARINE TELEPHONY.

THE first submarine telephone cable—that between Montevideo and Buenos Ayres, 50 kilometres in length—has just been inaugurated. Including the aerial line, the total circuit measures 302 kilometres. On this line there are five intermediate offices, which, owing to the adoption of the Van Rysselberghe system, can telephone and telegraph simultaneously with all the other offices. It was in August, 1888, that M. Laborde, who since that time has directed the whole of the works, was instructed by M. Ocampo Samanes, the promotor of the enterprise, to place himself in communication with MM. Mourlon and Van Rysselberghe to secure the execution of the project.

Commenting on the subject of long-distance submarine telephony a Belgian contemporary says: A work presented to the British Association by Mr. Preece, electrical engineer in chief to the Post Office, treats of the possibility and chances of success of telephonic communications between Paris and London, a project in which the French Minister of Posts and Telegraphs has taken the initiative, and which the two Governments interested are now considering. According to Mr. Preece's experiments—experiments in which he has endeavoured to realise as nearly as possible the conditions of the future line—there is not the least doubt that these communications are possible. We have ourselves stated, while Mr. Edison was in Brussels, that the distinguished electrician declared that the establishment of this line was impossible. Mr. Preece recognises that the conditions of the line are still far from being favourable, and probably do not exist in any other telephone line at present in working. Doubtless there are distances much greater than that between Paris and London which have been surmounted by the human voice by means of the telephone. Paris is only 440 kilometres from London; now the telephone has been successfully used between Paris and Marseilles, a distance of 960 kilometres; between New York and Chicago, a distance of 1,440 kilometres, and in America there are many telephone lines which have a length of from 450 to 500 kilometres, the working of which has for some time now been a commercial success. Between Montevideo and Buenos Ayres a line has just been opened. The cable is composed of seven wires, a millimetre in diameter. In the first place it crosses the space comprised between Buenos Ayres and La Plata; it then follows the coast line up to Punta de Lara, where it enters the waters of the Rio to reappear again at Colonia. The passage of the river was decidedly the greatest difficulty to be surmounted; not that it was difficult to lay a cable at the bottom of the water, but because it was necessary to preserve all the qualities of sound. Despite the distance and the passage of the river the voice reserved its most delicate inflexions. But in telephony success is much less dependent upon distance than upon the conditions of the line. For the line from London to Paris there is, in the first place, a subterranean circuit in the first named of those cities for a distance of some kilometres, then the subterranean circuits through several tunnels; and lastly, there is the submarine cable, with a length of 33 kilometres. Mr. Preece gives a graduated scale to measure, so to speak, the possibility and quality of telephonic communications between two points. The quantity, on which these depend, is given by the product of the resistance of the circuit by the current absorbed, the last named being naturally proportioned to the electrical capacity of the circuit. The Paris-London line would give a product which would permit of a hope being entertained of one day seeing the telephone working between these two great capitals.

THE GOOLDEN-EVERSHED OHMMETER AND GENERATOR.

To meet the want, long felt, of an apparatus for testing the insulation of installation wiring, dynamos and cables in course of manufacture, and for testing street cables whilst being laid, &c., Messrs. W. T. Goolden & Co. have produced the portable set illustrated in fig. 1. The generator consists of a portable magneto generator of special construction, and all that is necessary to measure the insulation resistance of any circuit is to couple the wires to be measured to the terminals, turn the handle, and the needle at once points to the number of thousand ohms or meg-ohms representing the insulation resistance.

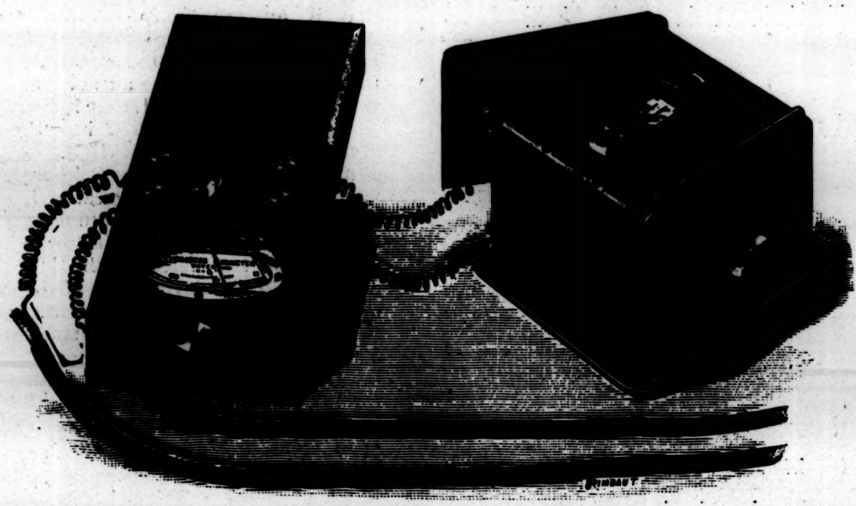


Fig. 1.

The advantage of this instrument, in speed and ease of measurement, is easily appreciated by those who have had to do similar work with a Wheatstone bridge; and the method is so simple, that the measurements may safely be entrusted to ordinary wiremen, who can thus make a proper return of each circuit as laid, enabling defective work to be discovered before covering in.

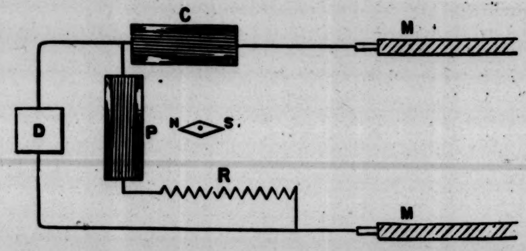


Fig. 2.

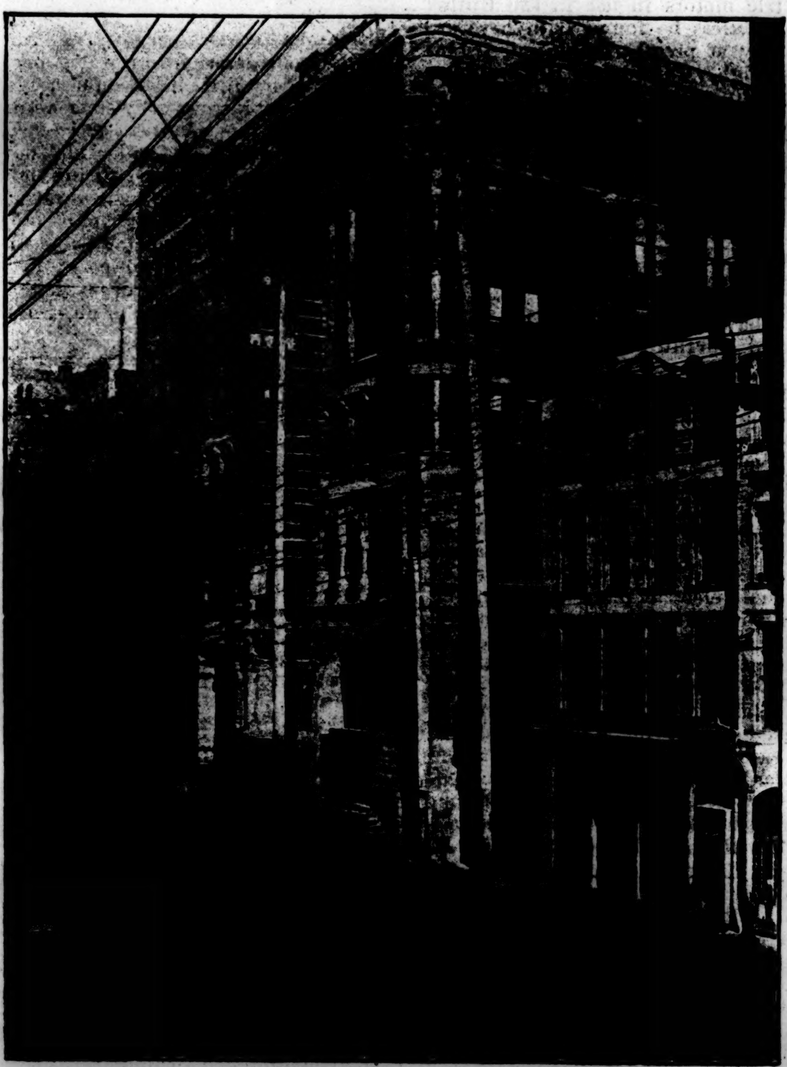
The generator, D, and current coil, C, are connected in series with the mains, M M, the insulation resistance of which is to be measured (see fig. 2).

The pressure coil, P, with a large resistance, R, in series with it is arranged as a shunt on the generator.

The direction of the resultant magnetic field due to the current and pressure coils depends on the ratio of the currents in them, and as the current in the former is $\frac{E}{r + x}$ where r is resistance of current coil and x the insulation resistance of the mains; and the current the pressure coil is simply $\frac{E}{R}$ where R is the total resistance, we see that the direction of the resultant field depends only on $\frac{r + x}{R}$

In addition to their use as ohmmeters these sets of testing apparatus completely dispense with the lineman's detector and battery. The generator alone may be most conveniently used for continuity tests during wiring of houses, &c., by keeping it connected to the main leads, and while it is being driven at moderate speed every pair of single-light leads is tested by making contact and noting the presence or absence of sparks. The whole process is exceedingly expeditious and certain.

A short circuit at any part of the ramification is instantly detected by the severe drag on the generator handle and sparking at its commutator.



How Wires are Run in New York.

The needle system being either astatic or placed in a field reduced nearly to zero by means of a neutralising magnet, the position of the needle, N S, depends on $\frac{r + x}{R}$; r is eliminated by the process of calibration, each division corresponding to $(r + x)$ ohms being marked as x ohms. The ohmmeters are usually made to read from 5 megohms down to 100,000 ohms on one scale, and the current coil is provided with one or two shunts to continue the range down to 10,000 or 1,000 ohms.

The generators are wound to give about 100 volts when the handle is turned at 120 revs. per minute. Of course the ohmmeter reading is independent of the E. M. F. employed.

HOW WIRES ARE RUN IN NEW YORK.

The building shown in the illustration is that of the Consolidated Exchange on Broadway, New York. It is in the centre of the business part of the city and the wires are probably as thick at that point as anywhere. The poles are on both sides of the street. Electric light, telegraph and telephone wires are fixed to the same poles.

We are indebted to Mr. G. S. Ram for the negative from which the block was produced, and we believe it was that gentleman's intention to make a few remarks last night upon this network of wires during the discussion on Mr. Addenbrooke's paper.

THE EMPLOYMENT OF ELECTRIC MOTORS.

NOW that electric motors have become a commercial article, and are practically reliable, it is certainly rather strange that in this country, at least, these machines have not come into greater favour than is at present the case, more especially as they could be advantageously employed in many branches of trade. This is all the more surprising when the great developments in the other branches of electrical engineering are taken into consideration, thus leaving, as it were, electric motors almost entirely out in the cold. If a correct and thoroughly reliable return were made of the number of electric motors in use in the United Kingdom it would doubtless be found that there are scarcely more than fifty at present employed, if, indeed, the figure is so high. In order to illustrate our argument, or rather to bring more prominently forward the purport of this article, namely, that electric motors can be profitably employed in the industries of this country, it may be well if we briefly refer to a few cases where these appliances are used.

The first installation in the United Kingdom, on a practical scale, was, we believe, put up in 1882 at the Trafalgar collieries in the Forest of Dean. The motors in this case are of the Elwell-Parker type, and are used for driving pumps. Three motors are in use—the first having been installed in 1882, the second in 1886, and the third in 1887, the results obtained being very satisfactory. Another example is at the Normanton collieries of Messrs. Locke & Co., whose installation is now so well known. Immisch motors are employed both for driving pumping machinery, and for haulage purposes. The useful effect of the pumping plant was over 40 per cent. during twelve months' working. At the Allerton Main collieries, near Leeds, several pumps are driven by motors, the current for the latter being obtained from storage batteries charged at the surface and taken down the pit. A small electric plant for pumping water into a reservoir is in use at the Kingscavil quarry, Linlithgow, Scotland. In this instance, also, excellent results have been obtained. Turning to the Continent we find several instances of the employment of electric motors. At the new Stassfurt salt mines in Germany a Siemens motor is used for driving a winding drum, the efficiency in this case being 40 per cent., and at the Salzberg works similar results have been obtained. Several instances in Switzerland might be cited, but the mention of the transmission plant between Kriegstetten and Solothurn will no doubt be sufficient. In the United States there are many instances on record of motors being used for driving winding drums, ore crushing stamps, coal cutting machinery, &c. In the Kimberley mines in South Africa there are several motors at work, and the mines are lighted electrically. Quite recently the Forbes Reef Gold Mining Company, of the Transvaal, South Africa, ordered some electric plant, including four long distance transmission motors, as already announced in this journal.

There is not the slightest doubt that with the erection of central electric light stations electrical energy will be supplied, not only for lighting, but also for power purposes. In this country the credit for having brought electric motors into practical application must be given mainly to Mr. Immisch, who has devoted considerable attention to the subject. The result of his labours is to be found in the fact that Immisch motors are now in use, as previously mentioned, in English collieries; they are employed for driving the electric launches on the Thames and in a few electric dog carts. Messrs. Paris and Scott, of Norwich, and Mr. Reckenzaun have also done a great deal to popularise electric motors by showing how they can be successfully and advantageously used in small industries. Other names might be mentioned, but the gentlemen cited have probably done the best part of the work. At the recent Birmingham Exhibition many examples were shown of the simple manner in which motors can be operated for driving various kinds of machinery and tools, and at the forthcoming Edinburgh Exhibition a similar display will be made. Now, there is no reason why electric motors should not come into general favour. In the iron and steel and engineering trades they could be profitably used for working shears, hammers, lathes, rolling mill machinery, &c.; in the coal trade, for winding, hauling, pumping, &c.; in the textile trade, for driving looms; and in various other trades for driving small machinery and tools. We must, however, not omit to mention the great field open for the employment of motors for traction purposes. There are already a few electric tramcars running in London and in one or two provincial towns, but this branch will soon be greatly developed, more especially as no less than 24 applications for electric traction powers have been made to the Board of Trade, and which will come on for consideration in the ensuing Session of Parliament. Very little has been done, except by Mr. Ward, in order to introduce electric omnibuses, and electric traction in this country is, as yet, but little more than an experiment. Considerable development in this direction will take place during the next three or four years, especially when the central stations have got in full working order. It would be well for manufacturers of motors to bring their machines more prominently before the notice of both great and small industrial concerns in order that the power business may not be behind that of electric lighting.

ON THE HEATING OF WIRES AND LAMP FILAMENTS.

By GILBERT S. RAM.

(*Concluded from page* 640.)

It is easy to see that, had Mr. Bernstein carried his observations to wires of rather smaller diameter, a size would very soon be reached where the same power would be required for the small wire as for the larger one to maintain it at the same temperature. If the atmospheric curve above be continued downwards a little way, it would seem that anything smaller than 3 mils. would actually for a given length take more power than the 10 mil. wire to maintain it at the same temperature.

Such a condition seems actually to have been attained by Mr. Evershed in the case of Cardew voltmeter wires. Mr. Evershed found that a platinum silver wire 1·4 mils. diameter required actually rather more power to maintain it at a temperature of about 180° C. than a wire of 3·5 mils of the same length.

It is interesting to note the falling off in the emissivity as the air pressure is reduced. In the case of the 3·55 mil. wire in reducing from 764 mm. (atmospheric pressure) to 4 mm., the watts per unit of surface have fallen off one-half, and in the further reduction from 4 mm. to practically 0 have fallen to one-fifteenth.

This difference in emissivity in the case of a poor vacuum and a good one is also shown in another table of Mr. Bernstein's, giving the energy per unit of surface for the temperature of 526° C. for carbon of diameters from 35 mils. down to 3·85. The value steadily increases as the diameter diminishes. This would be entirely accounted for by the fact stated, that "since the carbons were not made glowing a good vacuum was not obtainable."

Prof. Forbes in March, 1884, gave a formula for calculating the current required to increase the temperature of copper wires t° C. above the surrounding air; and he gave a table calculated therefrom. As the formula involves $c \propto d^{\frac{3}{2}}$, his table commences at 40 mils., and does not deal with smaller diameters. The formula includes the use of a coefficient of the loss of heat from copper. This has been determined by Mr. D. M'Farlane and also by Prof. Tait and Mr. Nichol, for both blackened and polished copper in air. Copper spheres several centimetres in diameter were used in both cases. As neither of their experiments appear to have been carried above 60° C., Prof. Forbes's formula is limited in its application to about that temperature. The values given by M'Farlane and Nichol agree fairly well for blackened copper, but not so closely for the polished metal. The latter gives about 10 per cent. greater value for blackened and about 30 per cent. less value for bright copper. This difference between the results probably lies in the different nature of the surfaces experimented upon, the blackened surfaces being more nearly alike than the bright ones.

Rise in temp. Cent. degrees.
Watts per 0·155 sq. in. surface.

Fig. 3.

Mr. Nichol also gives the loss of heat from blackened and bright copper at 102 mm. pressure and at 10 mm. pressure.

The falling off in the value is greater between 760 and 102 than between 102 and 10. The observations were, however, not taken below 10 mm. pressure.

It would be very interesting if someone would experiment on wires in air from, say ½ mil. up to 100, giving special attention to sizes below 20 mils., in order to find out what is the real law, connecting current with diameter, for any given rise in temperature.

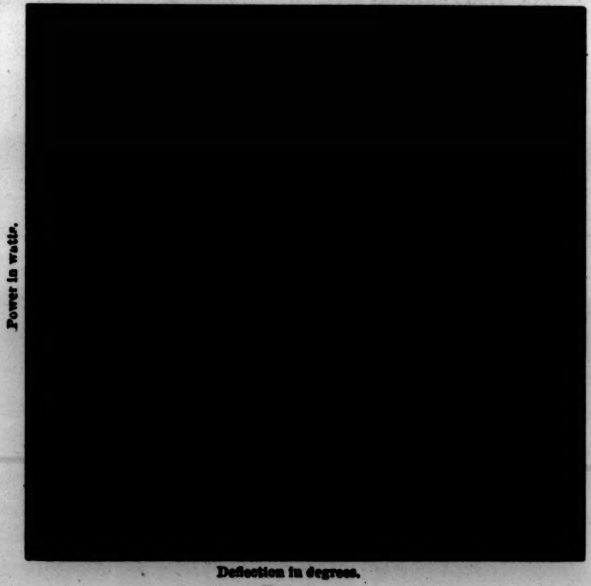


Fig. 4.

For very small wires the current does not seem to be proportional to the diameter, as has been supposed, or a small wire would not require more power than a larger one to maintain it at the same temperature. While for wires above 20 mils. the $c^{\frac{3}{2}}$ law does not seem to be quite satisfactory, although Mr. Preece's experiments show that it is tolerably near.

Although the whole of this range of diameters has been experimented on, it has been by different observers, using different metals, and each only taking a small part of the range. And for several reasons it seems impossible to gather anything satisfactory from the combined results.

About two years ago Prof. Ayrton stated that experiments of this nature were then being carried out at the Central Institution, but no results appear to have been published as yet.

Since writing the above, the writer has received from Mr. Evershed the results of further experiments on Cardew voltmeter wires. They fully bear out the statement, made by Mr. Evershed two years ago, as to the fine wires taking more power to maintain them at a certain temperature above the air than the thicker ones. Three sizes of wire were used, 3·5, 2·5, and 1·4 mils. Twelve feet of each wire was strung in a Cardew voltmeter. The expansion of the wire as measured by the deflection of the pointer on the dial, was taken as being proportional to the rise of temperature of the wire; 280° deflection being equal to about 180° C. The watts are calculated from the observed values of the volts and the calculated values of the resistance. That is to say, the observed value for the resistance was corrected for temperature by calculation. The resistance coefficient of platinum silver being taken as ·034 per cent. per degree Centigrade. The following curves show the watts per unit of surface for each wire for the whole range of temperature up to 180° C.

At any temperature, the diameter × the watts per unit of surface, is greater for the smaller wires than for the larger at that temperature. That is to say, at any temperature the total watts per unit of length, is greater for the small wires than for the large. This is best seen from the following curves of total watts and temperature. The wires in these experiments were in a vertical position. To what extent, if any, the results would have been modified, had they been in a horizontal position, it would be interesting to know.

Conductors, however, frequently have a cross section of other than circular form. The same conditions of surface and power hold in all cases, and therefore give a means of calculating the dimensions of any conductor or filament of regular form for any given rise of temperature.

Lamp filaments are made in some countries with a rectangular cross section, and some have a hollow tubular cross section.

In the latter case—

Let the outer diameter $= \mathrm{D}$,
" inner " $= d$,
let $\mathrm{D} = n\,d$,

then, as before, $\mathrm{C}^2\,\mathrm{R}$ is proportional to the surface, and therefore to D.

The resistance is proportional to $\frac{1}{\mathrm{D}^2 - d^2}$, from which is obtained

$$\mathrm{C} \propto \mathrm{D}^{\frac{3}{2}}\left(1 - \frac{1}{n^2}\right)^{\frac{1}{2}}$$

or

$$\mathrm{D} = a\left(\frac{c}{\left(1 - \frac{1}{n^2}\right)^{\frac{1}{2}}}\right)^{\frac{2}{3}}$$

and the length
$$l = b\,\frac{\mathrm{C.P.}}{\mathrm{D}}$$

the constants a and b have the same value as for the circular solid filaments.

This is apparent, for when $d = 0$

$$n = \infty,$$

and therefore $\mathrm{D} = a\,c^{\frac{2}{3}}$ as before.

For example, take the case of a 100 v., ·6 amp., 20 C.P. lamp.

Let $\mathrm{D} = 1{\cdot}1\,d$
$a = 9{\cdot}85$
$b = 1.645$

then $$D = 12{\cdot}52 \text{ mils.}$$
$$d = 11{\cdot}38 \text{ ,,}$$
$$l = 2630 \text{ ,,}$$

That is to say, that a hollow filament of these dimensions will have the same surface and resistance, and therefore be exactly the same as regards v., C.P., and efficiency, as the 7 mils. solid circular filament 4,700 mils. long.

Filaments of square section :—

Let the side of the square = S,

then $$C^2 R \propto \text{surface} \propto S,$$

and $$R \propto \frac{1}{S^2}$$

$$\therefore C \propto S^{\frac{3}{2}},$$

and $$S \propto C^{\frac{2}{3}},$$

or, $$S = a^1 C^{\frac{2}{3}},$$

and length $$l^1 = b^1 \frac{\text{C.P.}}{S}.$$

For example, take the same case of 100 v. ·6 amp. 20-C.P. lamp :—

$$a^1 = 8{\cdot}39,$$
$$b^1 = 1{,}292\,;$$

then $$S = 8{\cdot}39 \times {\cdot}6^{\frac{2}{3}} = 5{\cdot}95 \text{ mils.},$$

$$l^1 = 1{,}292 \times \frac{20}{5{\cdot}95} = 4{,}330 \text{ mils.}\,;$$

or, if the diameter for a filament of solid circular section be known, the side of the square for the equivalent filament of square section can be obtained directly from it.

Thus $S = A\,d \qquad A = {\cdot}85$

$l^1 = B\,l \qquad B = {\cdot}921$

therefore, in this example,

$$S = {\cdot}85 \times 7 = 5{\cdot}95 \text{ mils.}$$

$$l^1 = {\cdot}921 \times 4{,}700 = 4{,}330 \text{ mils.}$$

Filaments with Rectangular Section.—The width, thickness, and length, are here variable. Any one of them may be fixed arbitrarily, and the two others, corresponding to that value of the one, can be determined.

First, suppose the length to be previously determined upon. It is then necessary to find the corresponding width and thickness.

Let w = width of the filament

t = thickness of the filament

then the surface $\propto t + w$

and the section $\propto t\,w$

Let $t + w = \sigma$

,, ρ = resistance of unit length $= \frac{R}{l}$

then $$t\,w \propto \frac{1}{\rho} = \frac{K}{\rho}$$

therefore knowing $w + t$ and $w\,t$, t can be found.

$$t = \frac{\sigma}{2} \pm \sqrt{\left(\frac{\sigma^2}{4} - \frac{K}{\rho}\right)}$$

K = 1·368 = resistance of 1 square mil., 1 mil. long.

The length being previously determined upon as also the surface (C.P.) σ and ρ can be determined.

Thus in the case of the 100 volts, ·6 ampère, 20 C.P. lamp. Let the length of the filament be 4,000 mils.

$2\,\sigma\,l$ = surface (surface for 20 C.P. = 103,340 sq. mils.)

$$\therefore \quad \sigma = 12{\cdot}92 \text{ mils.}$$

$$\rho = \frac{R}{l} = \frac{166{\cdot}6}{4000} = 0\,0416$$

∴ from the formula

$$t = 3{\cdot}48 \quad \text{or } 9\,44 \text{ mils.}$$

i.e. $$t = 3{\cdot}48 \text{ mils.}$$
$$w = 9{\cdot}44 \text{ ,,}$$

Again, for the same volt, ampère and C.P.—

If length = 3,000 mils., $t = 1{\cdot}56 \quad w = 15{\cdot}66$

,, = 2,000 ,, $t = 0{\cdot}645 \quad w = 29{\cdot}185$

,, = 1,000 ,, $t = 0{\cdot}16 \quad w = 51{\cdot}51$

A filament with rectangular section is limited in length to that length for which its section becomes a square. In the other direction there is theoretically no limit. A rectangular filament may be as short as you please for any given volt, C.P. and efficiency. As it gets shorter it also gets thinner, and there is of course a limit to the thinness possible in the manufacture. The limit of length is obtained from the formula for square filaments. In the last formula it is when $\frac{\sigma^2}{4}$ becomes equal to $\frac{K}{\rho}$, and consequently the expression $\sqrt{\left(\frac{\sigma^2}{4} - \frac{K}{\rho}\right)}$ vanishes and $t = \frac{\sigma}{2} = S$.

In practice, however, when rectangular section filaments are made, it is usually not the length which is previously determined upon, but the thickness. The filaments are cut or stamped out of a sheet of the material; and it is then necessary to know to what width they must be cut or stamped.

Here the surface

$$\propto 2\,l\,(w + t) \propto C^2 R$$

and resistance $$\propto \frac{l}{t\,w}$$

from which

$$w = \frac{\sqrt{\left(t^2 + \frac{2\,p\,c^2}{t}\right)} - t}{2} \qquad p = 2{,}336 \qquad b'' = 2{,}580$$

and $$l = b'' \frac{\text{C.P.}}{t + w}.$$

For example: Required the width and length for 100 v., ·6 amp., 20 C.P., when the thickness $t = 4$ mils.,

$$w = 8{\cdot}44 \text{ mils.}$$
$$l = 4{,}160 \text{ ,,}$$

We have then these dimensions for a filament for 100 v., ·6 amp., 20 C.P.

(1) Solid circular section D = 7 mils., l = 4,700 mils.

(2) Hollow circular section, when outside diameter = 1·1 inside diameter.

$$D = 12{\cdot}52 \text{ mils.}$$
$$d = 11{\cdot}38 \text{ ,,}$$
$$l = 2{,}630 \text{ ,,}$$

(3) Square section

$$s = 5{\cdot}95 \text{ mils.}$$
$$l = 4{,}300 \text{ ,,}$$

(4) Rectangular section—(A) where length is previously determined,

when

$l = 4{,}000$ mils. $\quad t = 3{\cdot}48$ mils. $\quad w = 9{\cdot}44$ mils.

$l = 3{,}000$,, $\quad t = 1{\cdot}56$,, $\quad w = 15{\cdot}66$,,

$l = 2{,}000$,, $\quad t = 0{\cdot}645$,, $\quad w = 29{\cdot}185$,,

$l = 1{,}000$,, $\quad t = 0{\cdot}16$,, $\quad w = 51{\cdot}51$,,

(B) when thickness is previous determined—

when $t = 4$ mils., then $w = 8{\cdot}44$, $l = 4160$ mils.

In all these cases the surface and resistance are the same, and consequently the filaments are equivalent to one another in all respects. They must, however, all be made by the same process. That is to say, the emissivity and the specific resistance must be the same in all cases, and, of course, the vacuums must be practically perfect in all cases. Slight alterations in any one of these particulars will cause a considerable variation in the result. The greatest care is necessary in the manufacture of filaments in order to get uniformity.

Of course, the values for the constant given are only applicable to filaments made by the particular process for which they were obtained. Having obtained the value for the constants for any one formula, the values for those used with the formula for all the other shapes can be found. For instance, if the value of the constants, *a* and *b*, in the formula for solid circular filaments, be found by actual tests of a few lamps, for the particular kind of carbon under consideration, the constants for all the other shapes can be obtained from them. The longest filaments are obtained with the solid circular section, the ratio $\frac{\text{section}}{\text{circumference}}$ being then greater than with any other form. The next longest are obtained with the tubular form, with which any length, from that of the solid circular, down to approaching nothing, may be obtained. With rectangular section any length may be made, from the length where the section is square, downwards. Elliptical, polygonal, triangular or irregular forms had best be dealt with by the persons who may want them. It has been supposed that the efficiency of a lamp was in some way dependent on the form or nature of the surface of the filament. A hollow filament has been considered by some to have a greater efficiency than a solid one. Such, however, is not the case. The efficiency of a lamp depends on the temperature at which it is run; and any lamp may be run at any temperature. When at the same temperature, the watts per C.P. will be the same for all forms of filament and for all kinds of carbon, whether the emissivity be great or small. One lamp may be said to have a greater efficiency than another only when it will stand being run at a higher temperature without breaking or becoming deteriorated. The formulæ given above for filaments are equally applicable to all conductors for a given size of temperature, provided that they are of such a size or under such conditions that the loss of heat is proportional to the surface.

NOTES.

Electric Lighting in Glasgow.—At the last meeting of the Glasgow Town Council, Messrs. Muir, Mavor and Coulson, who at present supply the electric light within the central area of the city, approached the Gas Trust with a view of coming to some arrangement with reference to the provisional orders proposed to be applied for by that company and by the Corporation, but the sub-committee who considered the subject were of opinion that they could take no action with regard to the matter. In connection with the application being made to the Corporation for powers under the Electric Lighting Act, the Committee resolved to recommend that the capital proposed to be expended on the undertaking should be stated at a sum not exceeding £250,000.

Electric Lighting at Bournemouth.—With reference to the notices lodged with the Bournemouth Commissioners by the Anglo-American Brush Electric Light Co. and the South of England House-to-House Electricity Company, respecting their intention to apply to the Board of Trade for electric lighting powers for Bournemouth, it was decided to send a copy of a resolution which had been passed to the Board of Trade, expressing their wish to prevent a monopoly, and it was also decided to instruct the clerk to apply to the electric light companies for drafts of their provisional orders.

Bank Lighting in Manchester.—The Lancashire and Yorkshire Bank have transferred their business to a new building recently completed for them in Spring Gardens. The building is a highly finished specimen of architecture, and is much admired; in view of the electric light being shortly supplied by the Corporation, the rooms and offices throughout the building are properly cabled and wired.

Proposed Electric Lighting at Torquay.—At a meeting of the Torquay Local Board last Friday Mr. Newton, the deputy engineer of the Municipal Electric Lighting Company, who, with the Devon and Cornwall Electric Lighting Company, are applying to the Board of Trade for provisional orders for supplying electricity in Torquay, attended as a deputation from the company to support a communication from Mr. Gordon, chief electrical engineer, which dealt with the system, supply, and price. Mr. Gordon stated that the alternating current system would be the most advisable system to adopt, and that all the wires would be covered with insulation so that they might be handled with impunity. It was proposed, as a maximum, to charge 1s. a unit, but that price would probably be lowered. Mr. Newton, in answer to questions, said the company proposed raising £25,000, with powers to increase to £100,000. A discussion took place regarding the erection of posts, but the whole matter was referred to a committee which was appointed.

Electric Lighting and Politics.—One of the most important parts of the arrangements for the Balfour demonstration at Edinburgh was the electric lighting installation, carried out by Messrs. King, Brown and Company, Edinburgh.

Cost of Electric Light in Dundee.—Dr. Hopkinson has given a rough estimate of the cost of the lighting of the proposed area in Dundee. An installation of 1,000 incandescent lamps in that area would cost £5,500, and if 5,000 lamps were required the light could be produced as cheaply as by gas.

Electric Lighting at Newcastle.—An agreement has been sealed by the Council of Newcastle-on-Tyne enabling the electric lighting companies to go on with the laying of their underground cables.

South of England Telephone Company v. Coleman.—This case came on for hearing before Lord Coleridge and Mr. Justice Mathew, in the Queen's Bench Division, last Wednesday week. It was an action from the county court of Cambridge, arising out of a contract between the telephone company and a tradesman at Cambridge. There had been previous contracts between them as to the use of four telephone wires, and on March 20th, as appeared from a letter of the agent, Coleman, having given up his shop, agreed to take three wires for £24 a year, all to come due on October 1st; and on March 23rd, 1888, there was a contract in writing to carry this out, the rent to be paid in advance and to run from the commencement of April, after the laying on of the wires. The contract had a clause enabling either party to put an end to the agreement by three months' notice in writing. In August, 1888, Coleman gave notice to discontinue one of the wires. The company, however, claimed a year's rent for all the wires, and it not being paid, they brought this action to recover it. The case took nearly two days in trying, but at the end the Judge came to the conclusion that, the agreement being in writing, it was for him to construe it, and he construed it against the defendant, and considered he had no defence to the action, and so gave judgment for the company. The defendant appealed. The Court held the County Court Judge to be perfectly right; he rightly construed the contract, and there was no evidence of waiver. Appeal dismissed accordingly.

Innocents Abroad.—Mr. Addenbrooke wishes us to state that the remarks attributed to him in the article published in our issue of November 22nd were not correctly reported, and that therefore, through not having had the opportunity of making corrections, many inaccuracies had crept in. His running commentary was illustrated with diagrams on the black board, and without these some of his utterances appear somewhat unintelligible.

The Telegraph Construction and Maintenance Company.—We hear that this company has a large cable order on hand which will keep the works fully occupied for several months.

Hats as Telephone Receivers.—Attempts are still being made to force the "Pulsion" telephone upon the public, and it is stated that the Post Office has signified its intention of largely adopting the apparatus; this statement, however, we hear on Post Office authority is absolutely without foundation. Notwithstanding the opinion of a number of gentlemen, including Sir E. J. Reed, M.P., that this telephone cannot fail to become extensively popular, we venture to assert that this will not prove the case. If it should be so, the old hat trade ought to be profitable, for we are informed that an ordinary man's hat makes an excellent receiver. This being the case, just think of the result of applying an extraordinary individual's headgear to t'other end of the line!

The Lighting of Manchester.—Statutory powers will be asked early next year by the City Council for lighting by electricity a central district of Manchester, which includes a large area about Market Street, Deansgate, King Street, and Mosley Street. Provision is to be made also for an early future extension of the lighting to a large area on the other side of Market Street. The present gas-workers' dispute will probably greatly urge on and possibly enlarge the present scheme of municipal electric lighting.

Work and Wages.—We have received a letter from an electrical lineman whose complaint is that he has been offered 30s. per week by a provincial firm. In our opinion he has nothing whatever to grumble at. There may be no denial of his skill as a workman, and yet there are thousands of cases where responsible mechanics of undoubted ability are in receipt of a sum not exceeding that which has so greatly offended our correspondent. We might point out that very few firms would be inclined to give very large wages when a workman, however skilled he may be, proves by his communication that his education has been terribly neglected in other respects.

New Electric Boat.—Mr. Sargeant is building a second electric launch for Mr. Pears. "He won't be happy till he gets it."

Presentation to Prof. Tait.—In consideration of his long and eminent services as secretary of the Royal Society of Edinburgh, it has been resolved, by the Council of that body, to present Prof. Tait with his portrait. The commission has been given to Mr. George Reid, R.S.A., and the portrait is intended ultimately for the rooms of the Royal Society.

Appointment.—Mr. Sydney T. Dobson, M.I.E.E., late senior assistant engineer at the Vienna Central Station of the Imperial Continental Gas Association has been appointed chief engineer to the St. James's and Pall Mall Electric Light Company, Limited.

Lecture on Telegraphy.—Mr. Moir, of the Postal Telegraph Department, has delivered a lecture to the Bradford Scientific Society on recent improvements in telegraphy. He pointed out that since the days of Cooke and Wheatstone it had become possible, instead of using five wires for working a telegraph, to obtain, by the aid of the quadruplex and multiplex systems, four, five, and even six, separate mediums of communication out of one wire. The lecturer referred to the large quantities of electrical energy stored up at the relay stations—the great half-way houses of the telegraph system—and showed his audience how perfect and rapid fast-speed telegraphy had become in the hands of the scientific officers of the Post Office.

Telephonic Extension in Hampshire.—Another important step has been taken in connection with the rapid extension of telephonic communication in the county of Hampshire. On Monday week a new trunk line connecting Portsmouth, Southampton, and Winchester was successfully opened, and it is confidently anticipated that the new facilities thus afforded for intercommunication between the three most important towns in Hampshire will be widely appreciated by the commercial classes, whom it is more particularly intended to benefit.

Explosions in Underground Conduits.—Prof. G. Forbes, in a letter to the *Electrical World*, suggests that, as a more likely explanation than that of gas, a small leak in the insulation of the conductors would decompose any water in the conduit; there would then be an explosive mixture of oxygen and hydrogen given off, and, as the level of the water fell, contact between the conductor would eventually be broken, with the result of the spark. This would ignite any coal gas in the conduit, or, in any case, ignite the products of electrical decomposition, oxygen and hydrogen.

The Royal Society.—Last week the following papers were announced for reading:—O. Wiener and W. Wedding: "Remarks on Mr. A. W. Ward's Paper 'On the Magnetic Rotation of the Plane of Polarisation of Light in Doubly Refracting Bodies.'" H. Tomlinson, F. R. S.: "The Internal Friction of Iron, Nickel, and Cobalt, studied by means of Magnetic Cycles of very Minute Range." Dr. Spitta: "A Compound Wedge Photometer." We wonder if the last-named gentleman ever heard of the compound wedge photometer devised by the late Robert Sabine? Another paper, by Dr. Hopkinson, F.R.S., was down for reading yesterday:—"Magnetic Properties of Alloys of Nickel and Iron."

Gülcher Electric Light and Power Company.—A new catalogue has just been issued by this company, in which attention is called to the fact that whereas formerly the company's productions were practically confined to the apparatus required for a particular method of low-tension continuous-current arc lighting, the extension of lighting by incandescence led to the Gülcher machine being so much modified to suit the changing requirements of the trade, that it would be improper any longer to continue the old name. The intention is, therefore, to call it in future the Battersea continuous current dynamo. These machines may be used with equal advantage, either as generators or motors. The necessity of advance in the direction of supplying electrical energy by means of alternating current apparatus has induced the company to devote attention to the manufacture of complete equipments for central stations on this system, including the Battersea alternating current dynamo and the Battersea transformer. The catalogue gives particulars of all these, and also of a number of accessories, such as measuring instruments, regulators, engines, boilers, &c.

Teachers and Students.—Referring to the correspondence which has recently taken place in our columns on this topic, we may say that in 1872 there was no chairman of the Editing Committee of the Society of Telegraph Engineers. At that period, Prof. Ayrton was not a member of the committee, nor even on the Council of the Society, so that, naturally, he had nothing to do with the publication of papers or the general management. In 1872 Mr. Ayrton had not gone out to Japan, much less returned from that country. Of course, this is a complete reply to Mr. Varley's implication that Prof. Ayrton had anything to do with the suppression of his remarks in the Society's journal.

The Railway Diary.—We have received from Messrs. M'Corquodale and Co., Limited, the diary for 1890. It should prove useful to everyone concerned directly or indirectly with railway traffic.

Social Meeting of the National Telephone Company.—On Friday evening, in the Berkeley Street Hall of the St. Andrew's Halls, Glasgow, the National Telephone Company held their eighth annual assembly, upwards of 150 couples attending. The company was exceedingly gay and happy, everyone entering thoroughly into the merriment. Amongst those present were Sir Wm. Thomson, Messrs. J. B. Murray, of the State Line; Robert Gourlay, Bank of Scotland; John E. Watson, F. Douglas Watson, W. Alex. Smith, resident director; D. Johnston Smith, district secretary; W. R. W. Smith, D. Sinclair, district engineer; D. Dreghorn, David Johnstone, David Kinross, Wm. Aitken, assistant engineer, &c. During an interval Sir Wm. Thomson expressed regret at the unavoidable absence of Col. Jackson, the chairman of the company, whose health, unfortunately, had broken down through the great stress put upon it in managing such a gigantic and progressive concern as the National Telephone Company. The National Telephone Company was in a position of great power for doing public service, and in fact it was in a position of greater power than ever were the telegraph companies—that was, of course, relatively to the extent of the work to be done. He was proud to state that they were now telephonically connected with virtually the whole island of Britain; and, in fact, arrangements were also being made for putting the company in actual connection with every town in the island, so that any person, say, in Glasgow, Paisley, or Greenock, might simply ring to the Exchange and be put in communication with Brighton, London, Hull, &c. The National Telephone Company had 32,000 miles of wire in connection, while the "calls" were 73,000,000 per year, which was equal to 380 "calls" per minute, or more than 6 per second. Sir William concluded by hoping that they would all spend a pleasant evening. Dancing was then resumed, and was continued until an early hour next morning.

Our Columns.—As the Christmas holidays are approaching, we should be glad if our contributors will endeavour to send matter for the REVIEW as early as they possibly can. By doing so we shall be relieved of a considerable amount of trouble in the compilation of our index which will accompany the issue of December 27th, for practically we have to go to press several days in advance.

In a Multitude of Counsellors, &c.—The Electric Light Committee of the Wimbledon Local Board reported that they had obtained the assistance of Mr. Preece, Dr. Hopkinson, Captain Sankey, Mr. Kapp and Mr. Swinburne, and had been making inquiries as to the best way of putting the Board of Trade license in force, the result of which they hoped shortly to be able to state to the Board.

Underground Conductors. — Further information regarding the breakdown of the Siemens cable which we notified last week leads us to the belief that it was made for a normal difference of potential of 5,000 volts, but was being tested with double that E.M.F., and loaded to half its normal current, when it collapsed. It should be remembered that the maximum difference of potential between the conductors, this being a concentric cable, is presumably $\frac{\pi}{2}$ times the average, so in the case of 10,000 volts being applied the tendency to rupture is measured by $10{,}000 \times \frac{\pi}{2} = 15{,}708$ volts. Perhaps Mr. Alex. Siemens would not mind publishing the actual facts concerning this cable for the benefit of others who, we feel sure, would appreciate such a course.

Insulation.—There is a very excellent opening for any new insulation which can keep under control high tension currents whose proclivities for striking out new paths are beginning to assert themselves in London streets.

Copper.—Rumours of the extensive employment of copper for war munitions, if not for the actual construction of guns, point to extensive developments of such process as that of Elmore, and it seems that generally there is a good time coming for those who hold shares in companies dealing with this metal in any form.

Okonite Wire.—Messrs. Laing, Wharton and Down have sent us samples of this wire, accompanied by the following particulars:—"The insulation is practically all vulcanised rubber, treated with a compound which causes it to be absolutely without that porosity and pin-holing, which is almost always present in rubber compounds. It will stand a large amount of rough treatment, such as wires seldom require to undergo, and keeps its elasticity even when subject to weather influences of alternate moisture and dryness. If it were not for chance of mechanical injury it could be put underground in an ordinary excavated trench, without using earthenware or other piping, and keep its insulation. This latter is a very important point, as many wires may test well for short periods and then go entirely wrong. As an instance of severe work, we may mention that the wires in Chicago are run underground in the sewers on brackets coming out from the wall with ordinary common glass insulators. When the Chicago river is in flood the wires, insulators, &c., are completely under water; in the ordinary way they are damp, while at midsummer they are dry."

Sale of Electrical Patents and Machinery.—On Tuesday next, 17th December, Messrs. Wheatley Kirk, Price and Goulty, will sell by public auction, at Halifax, the patent rights, patterns and drawings of the Luther arc lamp and dynamo, with all the machinery, tools, and other effects of Luther, Hanson and Co., Limited, in liquidation.

The Gas Strike and the Electric Light.—The following letter has just come to hand:—"As the gas strike in South London seems to be approaching a crisis, as it has already done in Salford and Manchester, would it not seem advisable for manufacturers and suppliers of electric lighting portable plant to be prepared for lighting the public streets, if rendered necessary to do so by insufficiency of gas? Cable might be strung *pro tem.* from lamp-post to lamp-post with intermediate supports where required, the electric lights fixed inside the lamp-post glasses, and the whole supplied with current by portable dynamos, or, better still, by dynamos driven by steam-engines on the spot, such as would be found in saw mills, &c. The public would undoubtedly be pleased with the light that came to the rescue, and the comparison between gas and electric lighting would be more strongly brought into notice than ever.—DE MIEUX A MIEUX."

Edinburgh Electrical Exhibition, 1890.—The Brush Electrical Engineering Company, Limited, of 112, Belvedere Road, Lambeth, has secured the contract for the whole of the arc lighting at the forthcoming Edinburgh Exhibition. The lighting will be effected by means of about 350 Brush arc lamps each of 2,000 nominal candle-power run in series from Brush dynamo machines.

Institution of Electrical Engineers. — The last students' meeting of the present session took place on Friday evening last, Mr. Gisbert Kapp occupying the chair. A paper was read on "Electric Traction" by Mr. A. E. Childs, the discussion being maintained by the chairman, Messrs. Barton, Muir, and Poynton. After Mr. Childs's reply, a vote of thanks to Mr. Kapp terminated the proceedings.

Telegraph School.—The Roumanian Directoire General of Telegraphs has lately founded an electrotechnical institute for the purpose of educating pupils for the telegraphic service of Roumania.

Electricity in an Emergency.—In consequence of the serious strike amongst the gas *employés* in Manchester, and the total failure of the gas supply, the Lancashire and Yorkshire Railway Company decided to light their Victoria Station, which is the largest in Manchester, with the electric light, and, in order to show how quickly the work was done, within 6 hours of the time the order was given, the most important platforms were lighted, and the whole station was brilliantly lighted with about 250 incandescent and a few arc lamps within 36 hours, and yet the current had to be conveyed for about a quarter of a mile, and all the necessary circuits had to be run. The whole of the work was carried out by the company's telegraph and electric light staff, there being only about ten men on the work. The new light gives entire satisfaction, and has been running day and night for a week, and steps are being taken to have the light fixed permanently, the public being so well pleased with what has been done.

Opposition to the Central Railway.—The tradesmen of Oxford Street are opposing the new scheme. Meetings have been held protesting against the railway.

An Electric Light Company for Fareham.—A local company has been formed, and it is said shares are being taken up rapidly.

Chatham and Rochester Electric Light Company.—The second annual report of the Chatham, Rochester, &c., Electric Lighting Company, says that although unable to show a profit out of which to declare a dividend, it is now felt assured that the business is established on a commercially sound, and fairly remunerative footing. Quite two-thirds of the lights have been applied for, and are now installed, and as orders are still coming in, it is hoped by the end of the year that the remainder will be disposed of. A change has taken place in the management of the works by the resignation of Mr. Parker and the appointment of Mr. A. Maund.

The Reported Cable Split.—It was stated on Monday by a London daily that the Anglo-American Cable Company had disagreed with the Western Union Company, and that the former intended working alone. According to the officials of the Anglo Company, this statement is utterly without foundation.

Killing by Electricity.—The Daily Press report another death from contact with an electric wire in New York. The *post-mortem* examinations in the recent cases of death caused by electric wires have thrown much light upon the obscure pathology of such a death. In the above case, burns upon the palm of the hand showed that the current entered through the nippers used to cut the wire. The exit was disclosed by burns upon the forearm where it rested upon another wire. Although the direct path was scarcely one foot long, yet the heart and lungs showed numerous hæmorrhagic punctures, characteristic of death by electricity. The autopsy in the instance of the show-case accident, recently telegraphed, traces the death to an ill-made boot. Burns upon the foot directed attention to the chafing by a nail, which protruded through both sides of the sole, thus furnishing a metal contact with the iron grating. The popular alarm feeds upon such details, which appear to bring death within the circle of any one's daily life.

The Use of Electromotors in Germany.—*Industries* says: The use of electromotors for various purposes is making a satisfactory headway in Germany, especially for driving small printing presses, paint mills, and coffee roasters. Another use for the electromotor has been found in driving ventilators on shipboard from the same source of energy as is used for generating the current for the electric lights. The firm of Kummer & Co., of Dresden, have made a speciality of this type of apparatus.

Presentation to Mr. MacIver.—A musical *soirée*, presentation, and ball took place on Tuesday evening (26th ult.), at the Manchester Athenæum, to commemorate the recent marriage of Mr. Kenneth MacIver, manager of the Manchester district of the National Telephone Company, Limited. There was a large gathering of officials of the company and friends. After a pleasant programme of music had been gone through, the presentation of a gold repeater hunting watch to Mr. MacIver, and a pearl and diamond ring and a silver tea service to Mrs. MacIver, was made by Mr. H. P. Hughes, on behalf of the staff and business friends. He pointed out that Mr. MacIver was generally understood to have the longest record of any telephone official in the United Kingdom; and, as regarded Lancashire and Cheshire, he had been identified with every step in the progress of the telephone during the past 10 years. His individuality had left a permanent impress upon the form or mould of telephony in this important district. To illustrate the commercial development of the telephone during late years he might mention that there were now somewhere about 11,000 miles of telephone wires in Lancashire and Cheshire, about 5,000 being in the Manchester district alone. The total number of messages passing through the Manchester switch-room alone was about 9½ millions per annum, and no fewer than about one million of these represented messages between towns. The subscribers and business friends held Mr. MacIver in high esteem, and there was a bond of friendship between the manager and the staff. As a practical embodiment of the kindly appreciation and goodwill entertained towards Mr. and Mrs. Kenneth MacIver he had been deputed to make that presentation to them. Mr. MacIver briefly returned thanks on behalf of himself and his wife.

The "Dead Heart."—We have received from Cassell and Company, Limited, a most interesting souvenir of the play now being performed at the Lyceum. Illustrations of the various scenes are given by well-known artists.

Newspaper Science.—A provincial paper comments gravely on an electric current of 110 volts reducing paving stones to a molten mass, and considers 10,000 too horrible to contemplate.

The Proposed Electric Tramway between Bournemouth and Poole.—At the last meeting of the Bournemouth Improvement Commissioners, it was decided to instruct the Clerk to lodge objections against the Parliamentary plans and notices deposited by Messrs. Haynes Brothers for the construction of the proposed Bournemouth and Poole Electric Tramway.

The Lights Go Out.—Half the electric lights went out during a recital in the City Hall, Glasgow, on Saturday last.

National Telephone Electrical Society.—Mr. Wm. Ollerenshaw, inspector in charge of the Derbyshire district of the National Telephone Company, read a paper before this Society on the 6th inst., on the subject of induction coils. The paper was very ably handled, and, with suitable apparatus, Mr. Ollerenshaw was successful in demonstrating the laws of induction.

A New Cell.—It is said that Mr. Edison has perfected a new cell for telegraphic use which possesses some remarkable points in its favour. A cylinder of zinc, and inside this a thick stick of caustic soda in water constitutes the cell. It is claimed to have an internal resistance of only 0·025 ohm, and permits a discharge of 15 ampères, with an inappreciable loss by local action; an E.M.F. of about one volt, and to be free from polarisation, and never needs cleaning. These are very wide claims, and if they are substantiated in practice, the cell will have an extensive field of usefulness.—New York *Electrical Review*.

Recent Interruptions and Repairs to Submarine Cables and Landlines up to November 25th, 1889 :—

Between	Interrupted.	Repaired.
Cable.—Bahia-Rio de Janeiro..	21st September	6th October
„ Monte Video-Buenos Ayres	10th October	14th „
„ Santos-Santa Catarina ...	18th „	Still interrupted
„ Brest - St. Pierre (Anglo-American Company ...	18th „	Still interrupted
Landline.— Tchita-Nertchinsk (Siberia)	25th September	29th September
„ Wyniskowo - Nijné - Michailowsk (Siberia) ...	21st October	22nd October
„ Saigon-Bangkok ...	30th „	Still interrupted
„ Moulmein-Bangkok ...	15th November	18th November

Lightning in Belgium.—We notice that a series of articles has lately appeared in the *Journal Télégraphique*, giving statistics of thunderstorms in Belgium. It would seem that there exists some relationship between the extent of forests and the corresponding amount of damage effected by lightning. Some Swiss statistics show that in certain regions which have been gradually deforested the increase in fires due to lightning has been as follows :—

42 during the decade 1856–1865
46 „ „ „ 1866–1875
85 „ „ „ 1876–1885

The evidence at hand is considered by our contemporary sufficient to prove that as forests are cut down so the frequency and violence of thunderstorms increase, and that forests offer a large amount of protection against the various consequences of lightning.

NEW COMPANY REGISTERED.

Morris Brothers, Limited.—Capital, £5,000 in £1 shares. Objects : To purchase and continue the business of electricians and general scientific apparatus manufacturers carried on by Messrs. Morris Bros., at Hartington Works, Branston Street, Birmingham. To contract for the erection and supply of artificial illumination, signals, and cognate undertakings, and to make and sell steam and other engines, plant, machinery, instruments, articles and ingredients relating to any such business. Signatories (with 1 share each) : W. R. Morris (electrician), 246, Wheeler Street ; Wm. Canning, Handsworth ; Timothy Morris (electrician), Lozells ; Oliver Morris, Lozells ; F. Simmons, 38, St. Paul's Square, all in Birmingham ; E. Powell, Harborne, Stafford. Registered 5th inst. by Messrs. Kerly, Son and Verden, 14, Great Winchester Street.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Electric Arms and Ammunition Syndicate, Limited.—An agreement of 9th October, filed on the 23rd ult., provides for the purchase by this company from the American Electric Arms and Ammunition Company, of New York, of certain European patents relating to electric guns, cartridges and primers, for the sum of £23,500, payable £2,500 in cash, and £21,000 in fully paid shares of the syndicate. An agreement of 20th ult., filed 23rd ult., confirms the previous agreement. Registered office, 6, York Buildings, Adelphi.

Electric Wiring and Fittings Company, Limited.—An agreement of 22nd ult., filed on the 23rd ult., cites that the company undertakes to allot to Messrs. Latimer Clark, Muirhead & Co., Limited, or their nominees, 1,500 fully paid shares of £1 each. Registered office, 42, Duke Street, St. James's, S.W.

Notting Hill Electric Company, Limited.—An extraordinary meeting of the company was held 12th ult. at 9, Austin Friars, when the following resolution was duly passed :—"That in Article 5 of the Articles of Association the figures 9,548 in the fifth line of the said Article be struck out, and the figures 9,458 be substituted." This was confirmed on the 27th ult., and was filed 5th inst. The alteration relates to the numbering of the founders' shares.

Northern Electric Wire and Cable Manufacturing Company, Limited.—The statutory return of this company, made up to November 12th, was filed on the 5th inst. The nominal capital is £20,000 in £5 shares ; 1,462 shares are taken up, 660 of which are considered fully paid. Upon 802 shares the sum of £1 10s. per share has been called, the calls paid amounting to £942, and unpaid to £261. Registered office, Square Road, Halifax.

Woodhouse and Rawson United, Limited.—The statutory return of this company, made up to the 26th ult., was filed on the 5th inst. The nominal capital is £350,000 divided into 40,000 ordinary and 30,000 preference shares of £5 each. 27,651 ordinary and 16,858 preference shares have been taken up, and £2 10s. per share has been called upon the former and £3 10s. per share upon 12,458 of the latter, 4,400 shares being considered fully paid. The calls paid amount to £93,780, and unpaid to £10,606. Registered office, 88, Queen Victoria Street.

Cambridge University and Town Electric Lighting Company, Limited.—The statutory return of this company, made up to the 2nd ult., was filed on the 23rd ult. Only 7 shares are at present taken up, upon which no call has been made. Registered office, 2, St. Mary's Passage, Cambridge.

SAVE US FROM OUR FRIENDS.

We wish to bring to the notice of our readers a circular letter received by some of the members of the Institution of Electrical Engineers, giving notice of the intention of Major Flood Page to move the following resolutions at the annual general meeting of the Institution, held yesterday :—

Copy of Litho. Letter.

I. That the council be requested to place themselves in communication with the councils of the following bodies :—The Institution of Civil Engineers, the Institution of Mechanical Engineers, the Iron and Steel Institute, and the Institution of Naval Architects, with a view to the five institutions organising themselves somewhat on the lines of the British Association, having a general council representative of all five bodies, each body, however, retaining its autonomy.

II. That the council be requested to take into consideration the advisability of instituting voluntary examinations, and issuing certificates of competency as electrical engineers to those who pass such examinations with success.

The current year has seen the change of the Society of Telegraph Engineers and Electricians into that of the Institution of Electrical Engineers, involving as its idea the alteration of a Society having as its original aim mutual enlightenment and advancement into a body having a semi-public standing. The first resolution seems to us to be a further extension of this, inasmuch as it proposes to ally the Institution of Electrical Engineers, kindred societies, with that of the Civil Engineers, which is a body having by virtue of its Royal Charter a definite public standing. The idea of such an amalgamation is not new, having been proposed some years ago by the late Sir W. Siemens, whose scheme of the Hall of Applied Sciences will be in the recollection of most of our readers.

The matter then fell through, we believe, from the difficulty of finding a common basis on which the standing of the members of the separate bodies could be defined. This is now apparently attempted to be met by the second resolution, which obviously aims at inserting the thin end of the wedge for the establishment of a close corporation. Voluntary will soon become compulsory examinations, shortly to be followed by application for Parliamentary powers to enforce the validity of their diplomas and prevent unqualified persons from recovering fees, as in the case of the medical and legal professions.

This, we believe, to be an absolutely mischievous idea, even if it were possible to be realised, which we deny *in toto*. Mischievous, because in a profession like that of electrical engineering, an examination held to-day upon which a diploma might be granted would form no criterion of proficiency—say, five years hence. Mischievous again, because we utterly disbelieve that any examination can, in the present state of the science, be framed which would enable the examining body to decide whether the candidate was or was not a competent engineer ; and because it must often happen that the candidate is a thoroughly competent man in some branch of which the examiners are absolutely ignorant.

The professorial element already has too great a share in the management and conduct of the business and meetings of the

Institution, and if this resolution passes the Institution will soon develop into an assemblage of examiners and mere "*examination passers*," whilst the genuine engineer will be absent. By all means let the admission to the society rest on something more than it does at present, and let the standard be raised for the members and associates by insisting on their having been engaged, with credit to themselves, in some substantial engineering work, and then no examinations will be necessary to give members of the body a status, and the other institutions will be more ready to listen to a suggestion of amalgamation.

We trust that the Institution, as a body, did not endorse the ideas involving a close corporation by agreeing at four days' notice to the resolutions recited above, more particularly to the second of them.

CITY NOTES, REPORTS, MEETINGS, &c.

The Gülcher (New) Electric Light and Power Company, Limited.

The directors in their report state they are now able to present to the shareholders the first balance sheet for the twelve months ending June 30th, 1889, of the reconstructed Gülcher Company. The shareholders are already so well acquainted with the conditions of the reconstruction of the company that the balance-sheet calls for but few observations.

Although the agreement for sale by the liquidator of the old company was signed on February 23rd, 1888, the new company was unable to complete its purchase until August 31st, 1888, and therefore, had been on June 30th, 1889, in existence as an actually, trading company for ten months only.

The second debentures were issued to enable the company to carry out the lighting of the City of Wellington, New Zealand. The value at which the New Zealand contract is assessed in the balance-sheet is the actual cost price expended in time and materials on June 30th, 1889.

The central stations at Wellington were finished in the month of September last, and the public lighting has proved to be thoroughly satisfactory. The commercial success of this undertaking will depend entirely upon the ability of the company to provide capital for private lighting. The directors have laid down plant capable of distributing the current to the remotest parts of the City, and with a comparatively small further outlay a remunerative revenue could be obtained.

The directors propose to carry forward the surplus appearing to credit on the balance-sheet.

Particulars of other contracts undertaken and carried out during last year will be supplied at the general meeting, when a detailed profit and loss account will also be submitted to the shareholders.

Several alterations have taken place in the board of directors since the 23rd February, 1888, but all the directors on the board at present are original directors of the company.

This being the first general meeting of the company, all the directors retire, but, being eligible, offer themselves for re-election.

The directors having appointed Mr. Russell Day, formerly secretary of the Gülcher Company, to investigate, on their behalf, the accounts involved in the transfer of the Gülcher Company's business to them, decided to appoint him to audit the first balance-sheet and profit and loss accounts. It will be for the shareholders to appoint an auditor or auditors for the ensuing year.

Balance sheet to June 30th, 1889, is as follows :—Dr. : Capital issued, £12,241 1s. 4d. ; to Six per Cent. (1st) Mortgage Debentures, £8,000 ; to Ten per Cent. (2nd) Mortgage Debentures, £8,862 10s. ; to bills payable, £2,375 5s. 10d. ; to creditors (trade debts, interest on debentures to date, rent, rates, and taxes, law costs, &c.), £3,675 10s. 5d. ; to National Provincial Bank, £789 19s. 11d. ; balance, £405 13s. 10d. ; total, £36,350 1s. 4d. Cr. : By preliminary expenses (less written off), £800 ; by plant as valued, £6,726 3s. 1d. ; by stock as valued (at works and in London), £15,961 13s. ; by stock as valued (at agents' in England), £1,151 19s. 3d. ; by stock, plant, machinery, and buildings (at cost), being installation in Wellington, New Zealand, £9,598 18s. 8d ; by trade debtors and bills receivable, £2,054 18s. 5d. ; by cash in hand, £56 8s. 11d. ; total, £36,350 1s. 4d.

Fowler-Waring Cables Company.

THE statutory meeting of this company was held at Winchester House on Friday last, Mr. Wm. Fowler in the chair.

The Secretary having read the notice convening the meeting,

The Chairman said : They were aware that the meeting was merely a formal one. Immediately the company was formed the first point they had to consider was where should they proceed to work, to arrange for procuring machinery and the other things necessary for the work of the company. It was decided, if possible, to commence in London, and after a great deal of enquiry they found a place on the Thames at North Woolwich, formerly used by Mr. Henley, a great maker of cable, some few years ago. In Mr. Henley's time he visited the works, and when it was suggested that they would be suitable he thought so too. They had been secured on very favourable terms, and the company had made a most excellent bargain. Of course it would cost something to place the buildings in condition, but that would not be a very serious matter. The buildings were substantial and grand in their way, if he might be allowed such an expression. In his opinion if the whole were bought it would not exceed the amount which would have to be paid for erection. The machinery, to some extent, was already on the place, engines and boilers were up, and that very day the shafts were turning round. Early next year, in his belief, they would be in a position to take orders there for cables. As the shareholders were aware from the prospectus they had not been without business, because under the arrangement with John Fowler and Co., of Leeds, they would receive certain profits on the business. As that firm had been very busy making cables ever since the formation of the company, they were practically earning money now. Although cautious in making promises or prophecies he expressed his confidence in the company being a real success, and believed that they had got hold of a business which would be very satisfactory to the shareholders. He repeated that no time had been lost in endeavouring to set to work, and they were likely to do so practically within four months from the formation of the company. They could not very well have done more, and it was only by the accident of finding a place ready that he was able to make that statement.

Mr. Potter said cables were being used in Leeds similar to their own, this fact was rather alarming to shareholders, who thought they enjoyed a monopoly.

Mr. Eddison (engineer) said the cables used in Leeds had been supplied from Chicago to the National Telephone Company. Those cables, however, were drawn through leaden pipes, while the Fowler-Waring cables were covered with lead. He might say that the National Telephone Company had placed with them an extensive order for Leeds.

The Chairman said, had there been any question of infringement, they would soon have been down on the infringer.

An extraordinary meeting was then held for the alteration of certain words in the articles of association, which concluded the business.

TRAFFIC RECEIPTS.

The Brazilian Submarine Telegraph Company, Limited. The traffic receipts for the week ended 6th December, 1889, amounted to £4 944.

The Western and Brazilian Telegraph Company, Limited. The traffic receipts for the week ending December 6th, 1889, after deducting the fifth of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited, were £3,588.

THE COUNTY COUNCIL AND ELECTRIC LIGHTING.

AT the meeting, last Tuesday, of the London County Council (Lord Rosebery in the chair), Mr. C. Harrison moved for, and obtained leave to introduce, the London Subways and Overhead Wires Bill, the heads of which were agreed to in October last.

The following report of the Highways Committee was agreed to without discussion :—

"1. Your committee have considered a letter from the Board of Trade forwarding a copy of the regulations and conditions which the Board proposes to issue under the provisions of Section 10 of the South Kensington Electric Lighting Order, 1889, for securing the safety of the public and for ensuring a proper and sufficient supply of electrical energy. The Board requests that any observations which the Council may have to offer with reference to these regulations and conditions may be sent in at the earliest possible moment ; and your committee, having received and considered a report on the subject by Mr. T. P. Gunyon, of the engineer's department, are of opinion that there are a few points upon which it is desirable that the Council should suggest to the Board of Trade that some slight modifications should be made. They therefore recommend—That a letter suggesting these modifications be sent to the Board of Trade.

"2. Your committee have had before them an application from the Metropolitan Electric Supply Company for permission to run a service cable, in wood casing, from the company's main in the subway in Northumberland Avenue along the wall of the Grand Hotel lateral, for the purpose of supplying electricity to the shops under the hotel. Your committee see no objection to this, provided that proper precautions be taken for securing the rights of the Council with reference to the subway ; and they therefore recommend :—That the sanction of the Council be given to the laying by the Metropolitan Electric Supply Company, of a service cable from the main in Northumberland Avenue subway to the shops under the Grand Hotel, subject to the condition that the work shall be carried out, and that any damage which may be done to the subway shall be made good, under the supervision and to the satisfaction of the proper officers of the Council and at the sole cost of the company ; and further, that the company, before commencing the work, do give an undertaking, to be prepared by the solicitor, to pay such an annual amount for rent for the use of the subway as may be settled by agreement, or, in case of difference, by arbitration."

SOME OF THE EARLY HISTORY OF TELEGRAPH CABLE MANUFACTURE.*

HAVING been for some time past engaged in collecting information in connection with the manufacture and use of electric cables, and particularly on the history of lead pipe cable making, I received recently the enclosed newspaper clipping from an old scrap-book of my father's, which seems to me to possess more than ordinary interest as a curiosity of the early literature of this subject.

Prof. Alonzo Jackman, the author of the publication, was at the time connected with the Norwich University, of Vermont, and as early as 1843 is said to have described in his class lectures the ideas embodied in his letter.

The letter itself he made efforts to have published in leading metropolitan journals of the day, but failing on account of the supposed folly of his proposals, he resorted to the Vermont *Mercury*, a paper then printed at Woodstock, Vt., in which the letter was published, with Prof. Jackman's signature, under the date of August 14th, 1846. Respectfully,

JOHN A. BARRETT.

Brooklyn, *November 12th*, 1889.

"A GRAND SUBMARINE AND OVERLAND MAGNETIC TELEGRAPH."

MR. EDITOR,—Permit me through your columns to present to the consideration of Prof. Morse, of whom every American citizen is justly proud, and to your numerous readers, the following suggestions in relation to a "Grand Submarine and Overland Magnetic Telegrapb."

1. The following article is based upon these three well established principles, viz.:—(1) That iron and also water are conductors of galvanic fluid. (2) That India-rubber (caoutchouc) is not only impervious to and insoluble in water, but is a non-conductor of galvanic fluid.† (3) That lead is not very sensibly affected by oxygen or other substances while under water.

2. Were two iron wires, each one-tenth of an inch in diameter (stretched parallel to each other and some distance apart), from America to Europe, and lying on the bed of the Atlantic; and were the European extremities of these wires joined together, while the American extremities were attached to the two poles of a galvanic battery in action; yet, the galvanic fluid would not take the circuit of the wires, but it would pass from one to the other, by water communication, in consequence of the conducting property of this element.

The fluid may, however, be forced to follow the wires, by surrounding them with a coat of India-rubber; say, *one-tenth* of an inch thick. This is evident, since this article is a non-conductor of galvanic fluid, and is also unaffected by water.

To secure greater safety to the work, each wire with its India-rubber envelope should be encased with a lead tube,‡ or pipe, whose thickness may be, say, *two-tenths* of an inch. Such a pipe, according to the foregoing, would be *seven-tenths* of an inch in diameter. Apparatus thus protected would lie secure for ages upon the bed of the ocean; this is manifest from the non-effect of water on lead.

3. The specific gravity of the *apparatus* described in section 2 must necessarily be compounded of the specific gravity of iron, of India-rubber, and of lead. Now taking the specific gravity of rain water to be 1,000, that of iron is 7,788, and that of lead 11,352, and we will suppose that of India-rubber to be the same as that of rain water. From these data, together with the several dimensions of the apparatus given in section 2, we calculate the specific gravity of said apparatus to be 9,591. According to experiments referred to by Prof. Olmstead (see Olmstead's "Natural Philosophy," vol. 1, page 307). "At the depths of 1,000 fathoms, the compression of water is one-twentieth of its bulk, and its specific gravity is increased in the same ratio; so that bodies which sink near the surface of the sea may float at a certain depth before they reach the bottom." Query, would our apparatus float, and thus be exposed to the revelrout of deep-sea monsters?

According to the established principles in philosophy, a body will continue sinking in a fluid, so long as the specific gravity of the former is greater than that of the latter; and when they are equal it will stop. Hence said apparatus will descend to a point where the specific gravity of sea water is 9,591.

Now the specific gravity of sea water at the surface is 1,026, and according to the foregoing, at the depth of 1,000 fathoms, it occupies only $\frac{19}{20}$th of its bulk at the surface. Furthermore, at every succeeding depth of 1,000 fathoms, the bulk is decreased in the same geometrical ratio. Again, the density of the same fluid is inversely as its bulk. From these data we find, by calculation, that at the depth of 261,461 feet, 49½ miles, the specific gravity of sea water would be 9,591, the same as that of said apparatus. Consequently, the telegraphic pipes would not float until they had descended to the depth of 49½ English miles. Here would be a thick fluid, denser than iron, for the monster of the deep to sport in.

4. It is reasonable to suppose that the bed of the ocean bears a proportional resemblance to the surface of dry land. If this be so, the deepest places in the ocean cannot much exceed five or six miles. Prof. Hitchcock states in his geology that, "The mean depth of the ocean is probably between two and three miles." (De la Bache's Man. Geo., p. 2.) It has been calculated from the phenomena of tides that the Atlantic in its middle part is not above nine miles deep. (Phillip's Geology, p. 23, Edinburgh, 1838.)

The greatest depth ever conjectured has not, to my knowledge, exceeded 12 miles.

Hence, there is no doubt as to our apparatus sinking to the bottom of the ocean, for we have before seen that it would sink much lower than the estimated depth of the ocean, even to 49½ miles, should no bottom be found, and the water not become a solid.

5. By the work of coral insects and other analogous animals together with oceanic deposits, apparatus lying upon the bed of the ocean, as we have supposed, would, in a short time, be incorporated with and become a part of the crust of the earth.

Should fears be entertained that the internal volcanic heat of the earth would melt the India-rubber from the tattle wires, and thus let the tattle fluid escape among monsters of the deep—frightful to think of it! Why, to avoid all danger, let the telegraph be located out of a volcanic region.

6. The distance from Boston to Liverpool is 3,229 English miles; hence the total length of the two telegraphic pipes connecting those cities, after making due allowance for an uneven oceanic bed, and other contingencies, would be, say, about 6,600 miles.

According to the several dimensions of the respective parts of the apparatus given in section 2, together with its length, there would be required for its construction: 1, iron wire, 924,825 pounds, which would cost, at 10 cents per pound, $92,485 50 c.; 2, lead, 5,392,200 pounds, which would cost, at 5 cents per pound, $269,610; 3, India-rubber, 15,205 cubic feet, weight and cost unknown. Consequently, the whole weight of the telegraph apparatus would be about 3,000 tons, or each line of pipe 1,500 tons.

For the requisite purpose wire one-twentieth of an inch in diameter, instead of that described in section 2, would no doubt be sufficiently large. According to this view of the case, a lead pipe 1 inch in diameter would enclose within the same India-rubber wrapper about 36 tattle wires. Query, would not one wire answer the same purpose of the 36 wires lying side by side, were it not for strength and flexibility? Thus we see that with a very little increase of cost, so far as lead and India-rubber are concerned, the number of wires in each pipe may be greatly multiplied. By this means many cities, both in America and Europe, may have independent telegraphs protected by the same lead pipe, and thus enjoy uninterruted gossip.

8. There would be no serious trouble, I think, in reference to "pipe laying," for when we consider the skill exhibited by the Philadelphians and New Yorkers in this department of business during 1840 all fears vanish.

In reference to locating pipe, I will here venture the following suggestions: By section 6 one of the lines of said pipe would weigh 1,500 tons, half of which, 750 tons, would be a good cargo for a steamship. Now, let two steamships sufficiently large, each having 750 tons of said pipe judiciously coiled in the hold, accompany each other to a point half way between Boston and Liverpool; then let an artist splice the two halves of the apparatus together, wire to wire, rubber to rubber, and pipe to pipe. Next let one ship head towards Boston, the other towards Liverpool, and each "put on steam" and a pay-out pipe according to the circumstances of the case. The pipe would sink down and admirably fay to the bed of the ocean. In like manner, and at the same time, the other line of pipe might be located. Thus, in a few days, would be located in the two pipes 36 or more distinct telegraphs, by which 72 or more large cities might be connected; the proportional expense, for each city, would be but a drop in the bucket.

Instead of each pipe being located by two steamers, a greater number might be employed and kept in their proper direction by others (if necessary) stationed in sight of each other, for guides on the "line," as the locomotive steamers should respectively separate from, and meet with each other; well instructed artists might splice the apparatus, and let it go down. Thus in one day the two lines of pipe could be located from America to Europe.

9. Let us for a moment examine the cohesive force of our telegraphic apparatus, and see if it will be sufficient, while locating, to prevent the necessary strain from parting the work asunder. If a sufficient number of iron wires be taken, so that the aggregate of all their cruss sections shall be equivalent to one square inch in surface, these wires will together just sustain the weight of 113,077 pounds, while bad wire under the same circumstances will sustain but 3,146 pounds.

Furthermore, as before stated, the specific gravity of iron is 7,788, while that of lead is 11,352. (See Grice's "Mechanical Dictionary.") From these data, we calculate that were iron wire suspended in space, its cohesive force would be sufficient to sustain somewhat more than six miles of its own length, while under the same circumstances, the length of lead wire will fall considerably short; consequently were six miles in length of the apparatus (described in section 2) suspended in space, the lead pipe would part asunder, and slip off by the wire, leaving the interior wires, with their rubber coat, still aloft.

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* From the American *Electrical Review*.

† Dr. Turner, in his chemistry, classes India-rubber with the rosins, which he says are non-conductors of electricity; if, however, on examination it should be found otherwise, then all we have to do is simply to put a suitable coat of cloth, well saturated with varnish, around the wires inside the India-rubber envelope which would still be a useful protection.

‡ The telegraphic wires should in no case touch the lead pipe, lest a reverse current of galvanism might be produced. Furthermore, from the fact magnetism is mysteriously communicated to iron, when, without metallic contact, the galvanic fluid passes around it, we may anticipate some mysterious development in passing said fluid through a metallic pipe, though there should be no contact; experiment, however, will decide this point.

Now, in order to prevent the lead pipe from breaking, let strong bands of iron (each having holes drilled through them to pass wires) be slipped on, and well soldered to the exterior of the pipe; these bands should be at suitable distances from each other—say, 1,000 feet. Moreover, let a sufficient number of strong wires be stretched between every two consecutive bands, into which their extremities shall be well fastened; also let the whole be wound with spun yarn or something more suitable; and this in order to keep these exterior wires close to the pipe while handling it under various circumstances. Apparatus thus supported will sustain, of its own length in space, about five and a half miles, and in salt water about seven miles. Thus far we see that our apparatus will probably be adequate to any depth of the ocean. (See section 4.)

Should the ocean prove to be too deep for the strength of our apparatus to sustain a length that would reach to the bottom, it may, by means of attaching buoys, be suspended in the water at a suitable depth below the surface, and thus abate the strain that would otherwise be exerted on the apparatus while paying it out of the ship. These buoys should be of such a nature as would absorb the water slowly, and thus gradually sink and ultimately reach the bottom; for this purpose many kinds of season-wood will answer. If it should be thought necessary to retard the sinking process still more, the buoys might be overlaid with some chemical preparation which it would require the water a given time to dissolve. Therefore everything may become subjected to the will of the engineers. Hence said apparatus can be located with perfect safety in any desirable part of the ocean.

10. Of the 36 or more distinct telegraphs, delineated in section 7, let us suppose the distribution to be something like the following:—Let Boston, New York and Philadelphia each have four sorts of wires connecting them respectively, according to their choice, with four European cities. In the same manner, let Baltimore and Charleston each have one set of wires, New Orleans three, and Washington seven, connecting it, if necessary, with as many capitals in Europe. Moreover, suppose four sets of wires lead off from London, destined for Canada, China, Calcutta and Botany Bay; also, let four sets of wires from Paris be destined for the Pacific region, and let the Spanish and the Dutch each have two sets destined for their East India possession. In like manner more cities and nations might paricipate in the grand compound telegraph. Thus the 36 sets of wires are disposed of.

11. Let us now take a general view of the subject before us. Suppose the compound telegraph so located, that from the several European cities engaged in the work, their respective sets of wires should lead off to the verge of the ocean, there, along on the bed of the ocean, in lead pipes, to a point somewhere near the British Channel, where writing, the positive branches would form the positive trunk, and the negative branches the negative trunk; thence onward in the two main trunks to the American shore, where the two trunks would rise with majesty from the ocean, sending out and taking in wires as they passed Halifax, Boston, New York, Philadelphia, Baltimore and Washington; thence westward, accompanying Whitney's contemplated railroad to Oregon and the Pacific Ocean; thence along on the bed of the Pacific, dismissing and receiving branches as it passed the Sandwich and Phillipine Islands, until all the wires shall have reached their respective places of destination. This is the grand telegraph proposed to be presented in the heading of this article.

12. Who could calculate the blessings which humanity would derive from the effects of such a magnificent telegraph? I will just hint at a few items.

First, in a political point of view, war would be at an end, for I think it may be truly said that delay of intelligence is the life of war.

Both parties might discuss the subject of treaties at home. For instance, the United States Senate and the British House of Lords could sit, as it were, in their tent door in the cool of the day, and converse face to face upon great national questions; the experienced statesman will readily see the inestimable political advantage to be derived from said telegraph.

Secondly, on commerce.—The merchant can see how his purchases and other requisite arrangements may be made before his ships put to sea. All departments of his business would be stripped of the double perplexities and dangers now necessarily accompanying them.

Thirdly, in science.—General knowledge upon all subjects would increase mightily, until it should be equalised among the inhabitants of the earth, knowledge in meteorology would be systematised, and astronomical observations could be taken on different parts of the earth at the same instant, by which means much might be discovered that is now unknown. The longitude of places could be given to perfection. Time would fail me to mention all the advantages gained under this head.

Fourthly.—This would be a new era for missionary operations. Heathenism would be entombed, and the whole earth would be illuminated with the glorious light of Christianity; and this might be the time spoken of in Rev. 14: 6, "And I saw another angel fly in the midst of Heaven, having the everlasting gospel to preach unto them that dwell on the earth, and to every nation, and kindred, and tongue, and people."

Fifthly.—Civilisation would, of course, go hand in hand with other improvements, and all the inhabitants of the earth would be brought into one intellectual neighbourhood, and be at the same time perfectly freed from those contaminations which might under other circumstances be received.

Lastly.—When we consider the time, outfits, misfortunes, dangers, and loss of life, and retardations in business, which are now necessarily connected with all human affairs, and which might be avoided by the proposed telegraph, it is evident that such a work would every year infinitely more than compensate for its construction.

ALONZO JACKMAN.

Norwich University, Vt., *August 14th*, 1846.

PROCEEDINGS OF SOCIETIES.

The Institution of Electrical Engineers.

(Continued from page 651.)

CENTRAL STATIONS.

Coming now to central stations, those I went over were the new Arc Light Station in San Francisco, the Edison Station in Chicago, the Westinghouse Station in Pittsburg, and the Thomson-Houston Station in New York; and I may add that since my return to London I have had an opportunity of going carefully over the new Westinghouse Station in Sardinia Street, Lincoln's Inn Fields, the plant in which is entirely of American manufacture and pattern, and arranged in the American manner.

I might easily have seen many more stations, in some cases perhaps larger and better arranged than those I did see. But those I did see are, I think, all typical of the latest American work, and all were in the process of making large additions to their plant, so that they were quite up to date.

The station in San Francisco is near the railway station. It is a large brick building, erected entirely for its present purpose, about 250 feet long by 80 feet broad, with a ground and two upper floors, and has been finished about eight months. It is intended to provide accommodation for about 2,000 arc lights when filled up. At present it is furnishing current for about 600. It is arranged in the usual—I was going to say invariable—American plan of placing the engines and boilers on the ground floor, and arranging the dynamos, switchboards, and electrical portion of the station on the first floor. In this instance the second floor is used as a storehouse, and for general purposes.

The boiler-house forms one end of the building, and there was nothing above it. It is arranged for two lines of boilers, one on each side, one side only being filled up at present. They face towards the centre of the building, with a large space between for coals and general working purposes. The boilers were of the well-known water-tube pattern. This type, varied slightly in detail by each maker, seems to be in general use everywhere in the States. From the boilers the steam is led to a 650 horse-power single cylinder Corliss engine, which, by rope gearing, drives a single line of countershafting. I must say I was surprised to find that, in a new station so large as this, and one in which expense evidently had not been spared, the engine was neither compound nor condensing, particularly as there was water within a moderate distance. There was only this one engine in the station driving all the dynamos, though space was provided for three more as the amount of lighting increased.

The working of the station was therefore dependent on the single engine and line of shafting keeping in good order. The engine drove this line of countershafting as I have said, the loose pulleys being on the shafting. At the stations I visited where countershafting was in use I was struck with the care and completeness with which means were provided for adjusting the plummer blocks and bearings in any direction. The general idea was somewhat as follows:—The plummer block, or upright, stood in a cast-iron shoe with a flat planed bottom, through which the holding-down bolts projected. The holes for the holding-down bolts in the plummer block were bored large so as to permit a certain movement in the block. The edges of the cast iron shoe were turned up all round, and through these edges projected screw bolts, the points of which touched the plummer block. By loosening, then, the holding-down bolts at any time, and screwing or unscrewing the screw bolts as required, the block could be slewed slightly or adjusted to line with the greatest nicety and ease. Besides this, the under bearing worked in guides, being kept in its place by a strong screw projecting up from underneath. By working on this screw, and on the cap of the upper bearing, the height of the bearing could, of course, be adjusted with great exactness. With these means the brasses are also quickly and easily replaced; while if they get warm when the shaft is running, the bottom bearing can be slacked down. The Thomson-Houston Company in New York told me they did this, and their dynamos are on the same floor as the line of shafting. It is, of course, a still simpler and safer matter to do this when the dynamos are situated almost right above the shafting, as is the general practice in American stations. Leather belting of the ordinary description was in use, except for driving, where ropes are used, as I have mentioned. I found leather belting employed at each of the stations I visited.

These long lines of countershafting must, of course, be wasteful of power; still, it is worth pointing out that such shafting runs under the best conditions when doing work right overhead, since both the dead strain and the running strain on the belts to the dynamos tend to lift the line of countershafting, which, therefore, if the weight is properly adjusted, must run very lightly in its bearings. The method of driving from underneath is also economical in belting, since the weight of the belt hanging on the dynamo pulley causes it to have a good grip, and permits of a short length being used. The belts pass up to the dynamos through holes in the floor, the holes being elongated to permit the belt being tightened, if necessary, by screwing the dynamo along on its bed rails.

In each of the stations I visited in America, the upper floor carrying the dynamos was entirely of wood, strongly made, and supported from underneath at intervals by stout wooden uprights, but still of wood.

The weight of the floor in the San Francisco station is entirely supported by the wooden uprights, being only steadied at the sides. I was informed that at the old station in San Francisco, worked by same company, and which, I understood, was supplying about 1,200 arc lights, a good deal of trouble was experienced from the floor, which was fixed to the walls, and which, vibrating with the motion of the machinery, shook the brickwork. I found the vibration on these wooden floors less than I anticipated, considering the amount of machinery on them; but, of course, the motion of a good dynamo is very even, and if the joints on the belt are neatly made there is no jerking.

In this San Francisco station all the machines were Brush 60-lighters. From 50 to 60 lights in series on one circuit seems to be about the general rule for lighting in America when any number of lights is required. As all the machines are run from the same countershafting, and at the same speed, whatever work they may be doing, it is necessary to provide an automatic regulator to adjust the current through the field magnets for each machine when doing less than its normal output. On the other hand, if the circuit is a very long one—and I was told some of the circuits at San Francisco are as much as 13 or 14 miles—the number of lamps on the circuit must be reduced to compensate for the extra resistance, These Brush dynamos were all mounted on short iron columns about 9 inches high, so that they were lifted entirely from the floor. I was told that this arrangement was found very handy for keeping the machines clear and free from dirt, and for inspecting them. I did not notice much difference between the machines and those turned out by our friends on this side of the water, and the style of the workmanship seemed to be about the same. A light overhead trolley, with lifting gear, ran overhead so that it could quickly be brought over any machine, and I was informed that should a machine go wrong they could replace an armature in half an hour. In the older station in San Francisco a large number of Thomson-Houston machines are used, but Brush machines only are employed in the new station, as they find the Brush armature is more easily replaced, and is so much the easier of the two to repair if anything goes wrong. It is worthy of note in this connection that the latest advices from America inform us that the Thomson-Houston Company have bought the Brush Works at Cleveland, Ohio, and therefore presumably the Thomson-Houston Company will in the future control this interest as well as their own.

From the dynamos the mains are led to a long narrow shelf, where are fixed the resistances and indicating instruments for each machine. The mains next proceed to the switchboard, which is of the plug pattern—brass plugs with boxwood handles united by a flexible insulated cord. All the flooring being of wood, as it is in each of the stations I saw, and being kept clean and dry, the risk of getting a bad shock is not great, except by shunting the current through oneself, or getting in series with a main, which are not ordinary accidents.

At San Francisco the motor business is steadily increasing, and forms a welcome addition to the revenue of the station, without a very great additional expenditure.

I will now go on to the Edison station in Chicago. There is no necessity to describe it at length, as the plans on which Edison stations are constructed have been published over and over again.

The boilers, which are situated on the ground floor, are of the water-tube pattern—Heine arrangement. In this pattern, which seems to be a good deal used, the tubes are much more nearly horizontal than in the well-known Babcock and Wilcox type. All the tubes come into a large flat box at each end, and there are small manholes in the boxes opposite the ends of the tubes for getting at them. These flat boxes are prevented from expanding with the pressure by tubular stays, which pass right through them, and are expanded in their places. These small tubes serve as blow-holes for directing a jet of steam on the upper side of the tubes to clear them of ashes. They are kept plugged up with a stopper, under ordinary circumstances, to prevent the gases coming through. These boilers had a damper projecting downwards in the furnace opening, for directing the draught over the surface of the coals when firing, to cause more complete combustion and prevent smoke. This damper may have been of some use for the purpose, but it certainly made it a difficult operation to fire properly.

The engines were also in the basement, in the next room to the boilers. They were of the ordinary Armington-Sims pattern, single cylinder, and neither compound nor condensing. There was one to each dynamo, the dynamos being situated overhead on the floor above. The dynamos were of the ordinary Edison pattern, for, I think, 1,500 lights each. Everything was very neatly arranged in the dynamo room, the current being conveyed about by large copper bars. The walls were simply lined with resistances and indicators for the different circuits. In fact, the place gave one rather the impression of a wholesale clock store, though the attendant informed me they did not have much difficulty in keeping their resistances properly adjusted. All the mains are underground, on the three-wire system. Indeed, there is a good deal of underground work in Chicago, the Telephone Company also having a large number of cables buried.

The next station I visited was that of the Westinghouse Company at Pittsburg. It is situated in a large building of the warehouse type, quite in the centre of the town.

The boilers here are of the water-tube type, but heated by natural gas instead of coal. This natural gas is brought in pipes to the town from a distance of 35 miles. The company who own the line of piping—of which, by the way, Mr. George Westinghouse is also President—sell this gas to manufactories, &c., at a rate which is nearly equivalent to the cost of coal; so that, although the convenience is great in using it, the economy is not so large as might at first be anticipated.

Work at the Pittsburg station was in the first instance begun with two Corliss single-cylinder engines of the ordinary type, driving on to a line of countershafting; but this method of working has not been extended, and one of these engines has since been removed. The next additions to the station consisted of Westinghouse standard engines of 250 indicated horse-power, driving 2,500-light alternating dynamos. These engines stand on square blocks of concrete and masonry; the blocks for this sized engine are about 7 feet by 5 feet. The last additions are of the new type of Westinghouse compound engine. From a power point of view, as well as from an electric lighting point of view, the station has therefore something of historical interest.

While in Pittsburg I had an opportunity of going carefully through the Westinghouse engine factory with Mr. Ralph Bagaley, the vice-president and manager, and of seeing all the details of construction of each of the different types of engines.

The Westinghouse Company make three styles of engine, each worked by a piston valve and single eccentric.

The standard type is so well known that I will not say anything about it. In it, as you are probably aware, the steam valve is between the cylinders, and set at a slight angle to them, while the cylinders are set rather over their work, and not directly in a vertical line above the crank shaft.

The junior and the new compound engines are on somewhat different lines to the standard, while the main principles involved are nearly the same. In these two later types the piston valve lies horizontally along the top of the cylinder heads. It is operated by a single eccentric working outside the engine case in a vertical direction, the motion being changed to a horizontal one by means of an L piece attached to the engine case by a hinge. The whole movement is of simple character, and works exceedingly well. In fact, there are practically no more working parts in the compound engine than in the junior or the standard two-cylinder patterns, and the one is as simple as the other.

The standard type has now stood the test of several years' work very satisfactorily, and there is no room to doubt that the compound engine, constructed in the same shops and by the same method as the standard engine, will wear at least as well. The makers' tests show exceedingly good results for this compound engine—viz., from 18½ lbs. to 19½ lbs. of water per brake horse-power hour with condenser, and from 24 lbs. to 25½ lbs. without condenser. I saw the testing apparatus in the makers' shops, and engines undergoing their test preparatory to delivery, and feel perfectly confident that the figures given by the makers are thoroughly reliable.

I will not describe this engine more fully, although to do so would probably elicit an interesting discussion, as it would be wandering from the subject of my paper. On the other hand, the remarks I have made are not intended to compare the Westinghouse compound engine with any other engine of at all similar type, but rather to draw the attention of electrical engineers to the fact that there are now, at any rate, two large firms of the highest repute turning out this class of engine, and ready to guarantee economy and efficiency on a par with Corliss engines.

Returning to the Pittsburg station, five Westinghouse engines of 250 indicated horse-power drive five alternating current dynamos of 2,500 16-candle-power lights capacity each, besides the machine driven from the Corliss engine. The exciters are run from smaller engines. The engines driving the alternating dynamos make 250 revolutions per minute, the dynamos making 1,050 revolutions per minute. The power is conveyed overhead by belts to the first floor, where the dynamos are placed. Each of these dynamos is on a sliding bed, so that the belt can be tightened, and, as I have already said, the exciters are run separately from the machines. The machines are so well known it is hardly necessary to describe them. I may, however, perhaps with advantage say a few words on the construction of the armature, which is the least easy part to understand from written descriptions or diagrams. In Professor Silvanus Thompson's book on dynamo machines, the diameter of the armature is given at nearly twice its breadth. While this is true of the smaller machines, in the 2,500 machine—which is the standard size for large stations, and is the size employed in the new station in Sardinia Street in London—the length of the drum is considerably greater than the diameter. The drum itself is formed of thin iron plates, just like an Edison armature, only of larger diameter; and as the iron near the centre is useless, holes are punched in the sheets, which lightens the armature and secures ventilation. Round the outside of this iron core, and over the two ends, insulation is laid. As regards the coils of wire in which the current is generated, they are made in this way:—Beginning at the inner side of the coil the wire is wound on an oblong frame to correspond with the shape of the field magnets, one turn on the top of the other. The coils are only one wire thick—that is, there is only one layer of wire between the drum and the field magnets. When these thin flat coils are laid on the drum, the round ends of the coils are turned down at right angles over the edge at each end of the drum, and the connections from coil to coil are made. A small piece of wood screwed into the side of the drum, and projecting over the end of each coil, keeps it in its place. When all the coils are fixed in their places, sheets of mica are laid over them all round the armature, and bands of fine wire, with a little thicker insulation underneath them, are bound round the whole armature at short intervals, in exactly the same way as is usual with the armatures of continuous current machines. An armature made in this way has perhaps rather an amateurish look about it, but there is no doubt that they work well in practice, and give excellent results. It is further worth noting that as the field magnets are long and narrow—a ratio of at least 10 to 1 in the large machines—they cannot be very economical as far as exciting current is concerned. Still, since the exciting current, anyhow, bears such a small ratio to the energy which the machine will transform into electric current, this is not a very material point.

The mains are run from the dynamos to the switchboard in troughs cut in the joists supporting the floor, which is made to take up over these troughs.

The switchboard at Pittsburg consisted of a wooden frame boarded over, about 9 feet high and 12 or 14 feet long, and standing about 8 feet from the wall, so as to give room to go behind and make the connections. This, I may say, is the usual way of arranging switchboards in America.

The general type of switch used in America for alternating current work—and it is not confined to the Westinghouse Company—is exceedingly simple in construction and operation, as well as efficient. In general principle it is like an ordinary tobacco chopper. To the top of a small upright a lever is hinged, terminating in an insulated handle. The metal part of this lever has a hatchet-shaped projection cast on it, projecting in the same plane as the motion of the lever. When the lever is pulled down the hatchet-shaped piece sticks in between two spring pieces set up to receive it, and so makes contact. If the lever has two hatchet-shaped pieces attached to it opposite each other, and engaging in spring pieces on either side, according as the handle is thrown over in one direction or the other, we have a two-way switch. Unite two of these levers together by a cross bar of insulating material, with a handle in the middle, and we have a double-pole two-way switch. Place a spring in the columns holding the hinges on which the levers turn, to throw down the levers when nearing the spring contact-pieces on either side, and we have the complete article. These switches were all mounted on wooden bases. In fact, I saw no slate used in America anywhere for such purposes, except at the Electric Club in New York. In the new Westinghouse station in Sardinia Street, however, the whole of the switches are mounted on enamelled slate, and very nice they look.

One exciter is used for several machines; each exciter has a resistance in its field magnets, which can be varied. There is, moreover, a separate resistance in the field magnet circuit of each alternating machine, so that the E.M.F. of the machine can be varied while its speed remains constant.

Double throw-over switches are connected so that each alternating current machine can be connected to either of two exciters, and so that any main circuit can be run from any machine. The general principle followed is to keep the machines at work as fully loaded as possible. Thus in the day many circuits will be run off one machine, but as evening comes on they will one by one be taken off and put on other machines. The throwing over is so quickly done as to only just cause a perceptible flicker in the lights. All these switches were bare and unprotected.

I did not hear or see much of the method of running two separate machines parallel on the same circuit. Whatever may be done in isolated instances, it does not appear to be practised generally; indeed, with the American system of running a number of small circuits instead of fewer heavy ones, the desirability of doing so does not often come in.

I should like to endorse here what I see Professor Geo. Forbes said in his paper on foreign central stations with regard to feeders. The area which can be economically supplied from a central station has certainly been greatly increased by the adoption of 1,000 or 2,000 volts instead of 100. But at the same time our notions of the area which can be supplied from one centre have experienced a corresponding growth. If, then, such an increased area is supplied on a high-tension system from one centre, we have as great, or nearly as great, falls of potential to deal with as if the low-tension system were used over a correspondingly smaller area.

To secure the highest class of lighting, therefore, together with the flexibility desirable in an installation lighting a large area, the whole of the outside work should be based on as complete and carefully designed a set of feeders as from our present knowledge we should employ with a low-tension system.

On many of the Westinghouse feeders lighting at great distances, there is a fall of potential of as much as 10 per cent. To avoid pilot wires an indicator is used, which, I think, Professor Forbes has already described here. There is no regular voltmeter for driving machines by, but an indicator is used with but one single mark on the dial. When the machine is giving the voltage which is required at the further end of the feeder to keep the lamps at their proper brightness, the hand of the indicator will be right over the mark on the dial. The loss in the feeder will, of course, differ according to the current flowing through it; so, to allow for this, a compensator is attached to the indicator. The main current flows through the compensator, which is arranged to cause a slight back-pull on the needle of the indicator; this pull becomes greater as the current increases. As the current increases, therefore, a slightly higher voltage on the machine will be necessary to keep the needle in its place. The instruments have, of course, to be made so that they can be adjusted to the calculated requirements of each feeder. When once set right, however, their operation is simple enough.

The Westinghouse Company also use a piece of apparatus containing an adjustable converter, which enables them to supply current from the same machine to two feeders having a different fall of potential.

The Thomson-Houston station in New York is situated in Twenty-Fourth Street East, near the river, and occupies what was formerly a large sugar refinery. It is therefore a building of the warehouse class, but very strongly built. I was told that this station was neither so large nor so well arranged as their station in Brooklyn; but the latter, I regret, I had not time to see. Two boilers struck me here as out of the ordinary patterns. The simplest way to describe them is, I think, to consider them as large locomotive fire-tube boilers set on end. The tubes are about 15 feet long, and the water line is about 10 feet up the tubes. This gives a considerable steam space above, through which the fire tubes pass, superheating the steam generated, and thoroughly drying it. At first sight one might suppose this an uneconomical pattern, as the heated gases pass so quickly into the flue. But the gases appear to give out their heat well, for Mr. Foster, the station superintendent, told me the temperature of the gases going into the flue was not above 550° Fah. The lower portion of this boiler is, however, the interesting part. I cannot very well describe it without the aid of a diagram. The outer shell of the boiler is expanded out and prolonged about a couple of feet below the tubes. It is turned up at the bottom, and united all round to the crown plate of the boiler, into which the lower ends of the tubes are expanded. This prolongation of the shell then forms a circular hollow, or chamber, about 2 feet deep. The internal space enclosed by this hollow chamber forms the fire-box or furnace, and is about 6 feet in diameter. Any sediment collects in the hollow chamber, and can be taken out at manholes. There were two of these boilers in use, and it was in contemplation to increase their number.

The engine—and there is only one—which furnishes power to this station is a large compound condensing Corliss engine; the two cylinders being in tandem. It is a very fine piece of work of its class. It drives on to a large flywheel with a smooth face of about 60 inches breadth. This flywheel transmits its power to a line of countershafting, which is arranged on the floor above, by means of a large leather belt 58 inches broad and of great thickness. I think, in all, seventeen machines are run from this line of countershafting—fifteen 55-light arc machines and two alternating current machines; in this case the machines are on the same floor as the countershafting. The general construction of the Thomson-Houston alternating current machines is on the same lines as those of the Westinghouse Company. The main difference is that instead of the ends of the coils on the armatures being turned over the edge of the core, as in the Westinghouse machine, the armature has a sort of prolonged lip all round the outside at each end, and the ends of the coils lie flat on this instead of being turned over. To their smaller machines, also, the Thomson-Houston Company frequently add a commutator, and commute part of the current to excite the field magnets, as Messrs. Zipernowski, Deri, and Blathy are in the habit of doing. The switchboard here is on much the same lines as I have already described. It was all quite open and exposed; but I was told that, in view of an accident which had happened there a short time before, they proposed to cover the exposed parts up.

This way of leaving the working parts of high-tension alternating current switchboards exposed is not confined to American manufacturers; a good deal of the Continental work is even worse. Yet all the different patterns of switches and converters could be protected at a moderate cost, and by the exercise of a very moderate amount of skill and ingenuity. I cannot help thinking that not to do so, to save money in this direction, is false economy.

(*To be continued.*)

NEW PATENTS—188-.

18855. "An automatic attachment for electrical switches, gas and other taps or cocks, valves, &c." F. W. White. Dated November 25.

18897. "An improved quick-make and quick-break switch for electrical purposes." J. G. S. Cunnington. Dated November 25.

18908. "Improvements in switches for electrical circuits." W. C. Johnson and S. E. Phillips. Dated November 25.

18939. "Improvements in and connected with railway and tramway vehicles and with their propulsion by means of electricity." H. P. Holt. Dated November 26.

18953. "An improved electrode for secondary batteries or accumulators." G. Macaulay-Cruikshank. (Communicated by W. A. Johnson and J. N. Smith, Canada.) Dated November 26. (*Complete.*)

18979. "Improved regulator for electric currents." W. R. Michl. Dated November 26. (*Complete.*)

18989. "Improvements in secondary or storage batteries." W. F. Smith. Dated November 26. (*Complete.*)

18997. "Improvements in or relating to the connecting of an accumulator battery in alternating current circuit." A. J. Boult. (Cummunicated by A. Foeppl, Germany.) Dated November 26. (*Complete.*)

19004. "Improvements in suspenders and holders for electric glow lamps." W. White. Dated November 26. (*Complete.*)

19011. "Improvements in dynamo-electric machines." J. Hopkinson. Dated November 26.

19079. "Improvements in electrical instruments." F. Bryan. Dated November 27.

19080. "An improved construction of plates for secondary or other voltaic batteries." H. T. Cheswright. Dated November 27.

19108. "An improved instrument for registering electrical currents." W. H. Douglas. Dated November 28.

19129. "Improvements in electric dry batteries." C. R. Bonne. (Communicated by H. Meinecke, jun., Germany.) Dated November 28. (*Complete.*)

19135. "An improved lock-switch for switching on and off the electric current." G. A. Graham. Dated November 28.

19142. "Improvements in continuous current transformers of electrical power." J. Hopkinson. Dated November 28.

19153. "Improvements in phonographs." G. G. M. Hardingham. (Communicated by T. A. Edison, United States.) Dated November 28.

19190. "Improvements in and relating to induction coils and other electro-magnets." E. L. Lovell and A. F. Lloyd. Dated November 29.

19195. "Improvements in and relating to the laying of electric and other wires in streets and roads." R. Summers. Dated November 29.

19199. "Improved means for the prevention of polarisation in electric batteries." H. Badcock, W. Grunsell, and A. Walker. Dated November 29.

19216. "Improvements relating to the generation, distribution, and utilisation of electrical currents." F. J. Patten. Dated November 29. (*Complete.*)

19220. "Improvements in distributing electricity with alternating currents and apparatus therefor." Siemens Brothers and Co., Ld. (Communicated by A. M. Taylor, India.) Dated November 29.

19277. "A new or improved apparatus for measuring, indicating, and recording electric currents." L. E. S. Churchill. Dated November 30.

19283. "Improvements in apparatus for measuring electricity." L. B. Miller. Dated November 30.

ABSTRACTS
OF PUBLISHED SPECIFICATIONS, 1888.

10245. "Improvements in and connected with electrical safety cut-outs." E. Perrett. Dated July 14. 8d. The inventor employs a piece of wire of such a section as to permit the normal current of the installation to just pass through it without heating. This piece of wire is held in tension by a spring forming part of the circuit and made of such a form and so arranged relatively to the wire that if the latter should become the least heated through excess of current passing through it, the said spring shall immediately be released and break the circuit.

14095. "Improvements in and connected with dynamo-electric machines and electric motors for direct currents." J. Swinburne. Dated October 1. 8d. Consists in making a low tension dynamo whose electromotive force can be varied as desired. The inventor arranges one pair of brushes to collect the exciting current, the field magnets being wound in shunt; and another pair to collect the main current. The main electromotive force is then varied by shifting the main brushes. 3 claims.

14489. "Improvements in electric lighting." E. Ritter von Moese-Nollendorf. Dated October 9. 8d. Claim:—In systems of electric lighting the alternate application of currents of short duration, but of higher intensity than necessary for one lamp or one group of lamps for several lamps or groups of lamps, and the distribution of such currents in short intervals to several circuits, every one of which has intercalated one of several lamps, which are supplied direct by the alternating currents in such manner that the consumption of electric energy is not proportional to the number of circuits but increases in a far smaller proportion, substantially as described.

14843. "Improvements in electric meters." J. Oulton and J. Edmondson. Dated October 16. 8d. Consists of a train of wheels having a torsion balancc, the vibrations of the balance being accelerated or retarded by the current to be measured. The difference between the known normal speed of the train, and its speed when influenced by the current indicating the measure of the said current. 3 claims.

14888. "Improvements in electric cranes." T. D. Hollick, Dated October 16. 8d. Claims:—1. In cranes actuated by electricity, the friction gear by which the hoisting apparatus is set in motion, in combination with a screw, excentric, or equivalent device, actuated by a handle, by which the friction wheels are brought into contact or separated as desired, without materially affecting the speed of the electric motor, substantially as described. 2. In combination with the lever and handle by which the friction wheels are brought into contact and separated as desired, a second lever by which the hoisting clutch is thrown in or out of gear, the two levers being connected so that either operation may be effected by the movement of the same handle, substantially as described.

15183. "Improvements in electrical telegraphs." E. Edwards. (A communication from abroad by E. Cassalette and D. Kunhardt, both of Prussia.) Dated October 22. 3s. Relates to a telegraphic apparatus for the rapid transmission of telegrams operated by means of Morse signs. 5 claims.

15395. "Improvements in instruments for measuring and regulating electric currents and differences of potential, partly applicable to telegraphic purposes." P. Cardew. Dated October 25. 8d. Has for its object improvements in the class of instruments for measuring and regulating electric currents and differences of potential described in patent No. 623, 5th February, 1883, and more particularly to enable suitable indications to be obtained from a shorter length of conductor, and in a more convenient manner than has hitherto been the case, thereby rendering the instruments more portable and lessening the necessary expenditure of power. The conductor whose extension is to be measured, and which is in the form of a thin wire, several thin wires, or a thin strip of metal, is stretched by means of a flat spring formed of a metal having an equal coefficient of expansion for heat to that of the conductor. This spring is slightly bent by the pull of the stretched conductor as a bow by its string, only that in this case the bow is, as it were, cut in half at the middle, the other end of the spring being fixed, and the stretched conductor forming the chord of the arc or string of the bow does not meet the spring again, but is extended to the requisite length, and then attached to a piece of metal insulated from the spring, means being provided for adjusting the tension of the conductor by winding it on a peg or by slow motion screws, so as to alter the length of the conductor or move the point of attachment of its end slightly, as will be well understood. With this arrangement, and the curvature of the spring being slight, a large motion of its free end will be produced by a slight extension of the conductor, and this motion of the end will be still further increased if the conductor be not stached to the end, but to a point on the spring at some distance from the free end. 4 claims.

16479. "Improvements in storage or secondary batteries." H. H. Lake. (Communicated from abroad by Prof. H. Walter, of America.) Dated November 13. 8d. Consists chiefly in dissolving acetate of lead in vinegar and inserting into the solution thus obtained two carbon electrodes, which are connected with a generating source of electricity. 7 claims.

16766. "Improvements in electric lamps or lighting apparatus." A. L. Shepard. Dated November 19. 8d. Claims:—1. An electric lamp or lighting apparatus wherein the globe is arranged to move with the arc as the carbons are consumed. 2. The improved means, substantially as described with reference to the drawing, whereby means are provided for maintaining the arc in a central, or nearly central, position within the globe.

17127. "Improvements relating to conduits or conveyors for electric conductors." D. Y. Cliff. Dated November 24. 4d. Claim:—Conduits or conveyors made of stoneware, earthenware, or glass for electric conductors, as set forth.

17238. "Improvements in or relating to dry piles for electrical purposes." G. C. Dymond. (A communication from abroad by L. Moorthamers, of Antwerp.) Dated November 27. 6d. Claims:—1. A dry pile in which the depolarising compound surrounding the negative element is placed in a coarse linen sack, wound round from top to bottom with string, which is surrounded by the exciting mixture, the whole arranged and combined in a zinc cylinder which forms the positive element, substantially as described and for the purposes set forth. 2. The general arrangement and combination of parts forming the improved dry pile for electrical purposes, substantially as described.

17537. "Improvements in cells for secondary batteries." M. Bailey and J. Warner. Dated December 1. 8d. Consists in so forming the earthenware, glass, metal or other vessels employed for containing the secondary elements as that the gases evolved from, or forced into said cells during the forming or charging process, may be retained within the cell at any desired pressure. 6 claims.

17479. "Improvements in switches and appurtenances used in an electric circuit." F. B. Nicholson and E. J. Jennings. Dated November 30. 6d. The inventors construct the contact-making portions of the switch arms with divisions or saw-cuts all more or less horizontal and parallel, but running alternatively in opposite directions in such manner that these portions may (upon entering suitably shaped contact pieces or blocks) be capable of a certain amount of vertical movement, and in such action admit of the bearing surfaces still maintaining their faces horizontal. 3 claims.

CORRESPONDENCE.

Energy and Electricity.

My time is, probably, quite as much occupied as that of Mr. Leonard Joseph; and although I cannot recognise that there is any danger of an "endless controversy," I must perforce study brevity in replying to that gentleman's letter. What is really required is an elementary paper on "The Use and Abuse of Dynamical Terms"; and, with the Editor's permission, I may, on a future occasion contribute to the REVIEW something under this or a similar title. With metaphysics we have here nothing to do; neither are any of "my views" in question, excepting insomuch as I hold it as proven, and even as obvious, that force and energy are not the same thing, and that "electricity"—taking the word in its sense of "a quantity or factor involved in electrical phenomena"—is not a "force," and is not a "mode of energy." It is not merely "my view" that terms should either be defined or employed, here, in their accepted scientific signification, and that a writer on any subject is required to know something of what is generally known on that subject, and to be clear and logical in all statements.

Surely Mr. Leonard Joseph must have some other definition for *electricity* than that of a common *class-name* for a number of forms of intermolecular motion? He did not use the word in this sense when he said that "A good many—and amongst others myself—support the view that *electricity* is a form of energy." A "class-name" cannot be a form of energy. I must assume that, in making this statement, he used the term in the same sense in which it was used when "quantity of electricity" was measured by the number of sparks (of given length) from "unit jar," and in which it is used when we say that this factor is measured in *coulombs* or *ampère-hours*.

This being premised, I may say:—

1. All electricians make a distinction between electricity and electrical energy. The former (Q) is measured as above; the latter ($QE = CE \times$ time) by *Joules* or *Watt-hours*.

2. Physics end, and metaphysics commence, at the *atom*.

3. What is correctly termed "density of current," may be described as "intensity of the intermolecular motion;" but it cannot be maintained that a *static charge* of so many coulombs varies as, or has any relation to, such motion.

4. The researches referred to as to the relation between conductivity and a high boiling point, elasticity and small atomic volume may be of considerable value, but cannot tend to prove that "force" and "energy" are one and the same thing.

5. I cannot comprehend the connection between the following products and increase of resistance with temperature (which does not obtain in fluids, generally); but it is quite true that *force* varies as (in fact *equals*, in any absolute system) the product of mass into an "accelerating force," and that *momentum* varies as mass into velocity. It is *not* true, however, that an accelerating force is "a species of velocity," or that the force acting upon a given mass is "a species of momentum."

6. Work and potential energy are of the same dimensions, and convertible; moreover, they are expressed by the same unit—*e.g.*, foot-pounds or gramme-metres. A kilogrammetre of work and a kilogrammetre of potential energy of course correspond to the same quantity of kinetic energy.

7. I do not know that the precise series of equations (*f*) will be found in any text-book; but, as many of my old pupils will recollect, something equivalent was a *sine quâ non* for admission to my electrical classes at the "School of Electrical Engineering." In most cases, however, the accelerating force or acceleration (a) was taken as unity and omitted, as in the *gravitation system* of measurement, adopted by engineers, and involving, in this country, the *foot-pound* as the unit of work or energy. The equations, as they stand, apply to any absolute system of measurement.

8. The formulæ given in (*f*) are *not* misleading, and are *not* merely ratios, but equations, arithmetically. I will translate them into ordinary language.

(In the case of a mass raised through a distance (s) which is small as compared with the diameter of the earth),

The *work* done equals *the accelerating force of gravitation* × *the mass raised* × *the space through which the mass is raised.* (I.)

In gravitation measure, g, the accelerating force of gravity, is taken as unity; in absolute measure, g, = 981·17 centimetres at Greenwich = 980·94 centimetres at Paris. In Attwood's machine, $a = g\,\frac{M - m}{M + m}$.

The *accelerating force*, or, as I prefer to call it, the *acceleration* (measured by the effect upon *any* mass) is *velocity* divided by *time*, or *velocity obtained in unit time.* (II.)

The *acceleration* × *mass* = the *force* acting on the mass, and tending to produce motion.

Thus the *weight* of a mass of 10 lbs. or the *pull* of g upon this mass is, in *gravitation measure*, *said to be* 10 lbs. or 4534·148 grams (anywhere).

In the foot-pound-second absolute system it *is*, at Greenwich, 32·19 × 10 = 321·9 *poundals*.

In the metre-gram-second absolute system it *is*, at Greenwich, 9·8117 × 4534·148 = 44,487·7 M.G.S. units of force.

In the centimetre-gram-second absolute system (which is that generally adopted in science) it is, at Greenwich 981·17 × 4534·148 = 4,448,770 *dynes*.

A *force* is always either a *pressure* or a *pull*.

The *work* done is the given *force* × the *space* through which this force is overcome. (I*a*.)

Now, by the principle of the conservation of energy, the mass, in falling through the given space, will acquire kinetic energy equal to the work done in raising it. In uniformly accelerated motion,

The *space* through which a mass has fallen = half the velocity acquired × the time during which the mass has fallen. (III.)

(From II.) In any absolute system, the *time* during which a mass has fallen = the *velocity* acquired divided by the *acceleration*.

(Substituting this value in III.),

The *space* fallen through = the *square of the velocity obtained*, divided *by twice the acceleration.* (III*a*.)

Whence

The product of the *force* into the *space* through which it is overcome, or the *work* done, is equal (arithmetically) to the product of the *mass* into half the *square of the velocity*, which product is the expression for *kinetic energy*. Q.E.D.

In spite of my endeavours to study brevity, this letter has already reached such an inordinate length (for a letter), that I must defer the remainder of my answer until next week.

Desmond G. FitzGerald.

Cable Making.

Mr. W. Fowler, chairman of the Fowler-Waring Cable Company, Limited, is reported to have stated at that company's statutory meeting on the 6th inst.:—"We found a place on the Thames, at North Woolwich, formerly used by Mr. Henley, a 'great' maker of cables, but long since 'deceased.' As this statement may be taken to imply that the late Mr. Henley ceased to manufacture cables after giving up the works Mr. Fowler referred to, I beg to state Mr. Henley forthwith adapted adjoining works, and fitted them with the most modern and approved machinery for cable making, and that these latter works, and all Mr. Henley's patents connected with submarine and other cables, were, in 1880, sold to our company, Mr. Henley continuing the management until his decease in 1882.

A large proportion of your readers are, of course, aware of the continued activity of these works, as amongst your readers are, no doubt, included most of our customers, but to avoid any likelihood of error we shall be glad if you will kindly insert this letter in your next issue.

As a matter of fact, since Mr. Henley's decease, the company has reaped the benefit of the great development of electrical industries, and the business has tripled, or quadrupled, since 1882, many tons of copper being now used per week for electric light conductors alone, in addition to which we have considerable employment in making telephone, telegraph, and other wires and cables, our out-turn of submarine telegraph cable during the present year having exceeded a thousand miles.

G. Sutton, ***Manager and Secretary,***

For W. T. HENLEY'S TELEGRAPH WORKS COMPANY, LIMITED.

December 10*th*, 1889.

Ozone.

We read with interest your correspondence on the above subject, in your last issue. We are sure your practical readers would feel obliged if Mr. Ernst Fahrig would kindly favour them with the method of producing ozone on "an unlimited *commercial* scale and for *commercial* purposes."

We have found our "flame spark coils" very applicable for the production of this allotropic modification of oxygen, by virtue of the immense density of the brush discharge, and we would much like to know a *few* of "the hundreds of uses" for this electric effluvium!

Pike and Barnett.

December 10*th*.

Seeing to a Distance by Electricity.

In your issue of November 29th, under the heading "Seeing to a Distance by Electricity," you publish a description of a proposed method of seeing by electricity, but I gather from the remarks on the mechanism to be employed, that no actual trial has been made.

Some seven years ago (1882) I designed an identical apparatus and conducted a considerable number of experiments with roughly constructed models of the apparatus (which models I still possess), and it may interest some of your readers to know how far the experiments were successful, and why they failed to give the results anticipated.

The apparatus consists essentially of the *transmitter*, the *line* and *synchronisers*, and the *receiver*. In the line and synchroniser I include the arrangement of inclined mirrors or oscillating prism or lens which may take its place.

One reason that leads me to suppose that the apparatus, as described, exists so far only on paper, is that selenium is the medium for transforming the light variation into the electric variation, whereas all my experiments, and so far as I have been able to gather the experiments of others, show it to be unsuitable, on account of its great variation in sensitiveness with varying battery powers, and even in course of time by molecular change, whilst its high resistance makes the currents available very small.

Coming also to the receiver, I am aware that more sensitive or louder speaking magnetic telephones are made now than when I tried my experiments, but I was unable to produce, by means of the magnetic telephone, any variation in a gas flame, with the movement of the plate, producible by variation in current, such as a selenium transmitter, or even a microphone (acoustic) transmitter will give. Probably the reason of this is that the sounds are produced in a telephone more by molecular movement in the plate than by molar movement of the plate.

Having thus mentioned how far the experiments succeeded in the form described, I will mention some further experiments made on the same lines.

In place of selenium, I have tried as a transmitter a mixture of carbon and sulphur, in this case the luminous variation being first transformed into a heat variation, and owing to the sensitiveness of this mixture to heat, as affecting its resistance, into an electrical variation.

The variation, however, was neither powerful enough nor rapid enough. Similar experiments with thin metal films, after the manner of Prof. Langley's "bolometer," gave much the same results.

Coming to the receiver, and abandoning the magnetic telephone, I tried the "moto-graph" or chalk-cylinder telephone of Edison, and in this case the gas flame movement can be obtained with the variations that could be produced in a microphone (acoustic) transmitter, and I think with the variations obtainable with the selenium transmitter. (I do not now remember this with certainty.) But here the defects of the gas flame receiver are apparent. It is not sufficiently dead beat, the position of the gas flame depends not on the position of the telephone membrane, *but on the rate of change of its position*, which is not quite the same thing, as a little consideration will show.

Of other magnetic forms, I tried an electro-magnet with a light stiff armature, carrying a thin plane plate, pressing against a slightly convex plate, so as to give a series of Newton's rings. Viewed by monochromatic light (sodium flame), the centre spot is black or light, by a variation in position of half a wave length of yellow light. The chief defect of this form is that the illumination is scarcely intense enough to sufficiently impress the retina for the purpose in view. I also tried forms in which a small mirror was strung on a tightly-stretched wire, so as to have a very small time of oscillation, the movement of the magnetic armature being highly magnified by several different devices. They did not prove, however, to be sufficiently deat beat.

Having shown in what way these experiments failed, and having since studied the subject further, I might suggest what appears to me to be the most probable lines for investigation now offering.

1. The use of electro-chemical transmitters—that is, small cells in which silver bromide is formed by electrolysis—and the action of light on this salt, producing some other salt (? sub-bromide), alters the E.M.F. of the cell. Various researches on this subject have been published which appear promising.

2. The use as a receiver of a Geissler tube, more especially a "stratified" tube, the action here being very instantaneous and the position of the strata alterable by trifling alterations in condition.

Llewelyn B. Atkinson.

Historical Note.—The idea of using an integrating apparatus for producing the whole image from one element in the time during which the image will remain on the retina was first, I believe, *published* in the *English Mechanic* about 1881 or 1882, and was then, as far as publication goes, new.

Accumulator Installations.

I have read with interest Mr. G. Prescott's paper on the above subject, completed in the last issue of the REVIEW, and seeing that he has not described or suggested any better method of running lamps during charging hours than the usual one of introducing resistances or counter E.M.F. cells with automatic governors and continual waste of power, I venture to submit an arrangement capable (when the dynamo is near the accumulator) of completely abolishing these extravagant and somewhat complicated devices, and, at the same time, possessing other advantages, while not increasing the first cost by any very large amount.

In the diagram herewith, B D is the "battery dynamo," the sole duty of which is to charge the accumulator, and D D is a "direct dynamo" for feeding the mains, W and X; the former machine being, as usual, shunt wound and the latter compound, for maintaining constant E.M.F. The two dynamos may with advantage be built on one bedplate and have their armatures on a common shaft. A S and R are the usual automatic switch (or "mousetrap"), and resistance. F M is an extension of the field magnet winding of

B D, in which, as in other circuits, a quick-break switch may be placed in addition to the slow-break switch shown; A A are ammeters; V V voltmeters; Q S, Q S, quick break switches, for breaking circuit before the corresponding slow-break switches are moved over. The remainder of the diagram will be readily understood without further explanation.

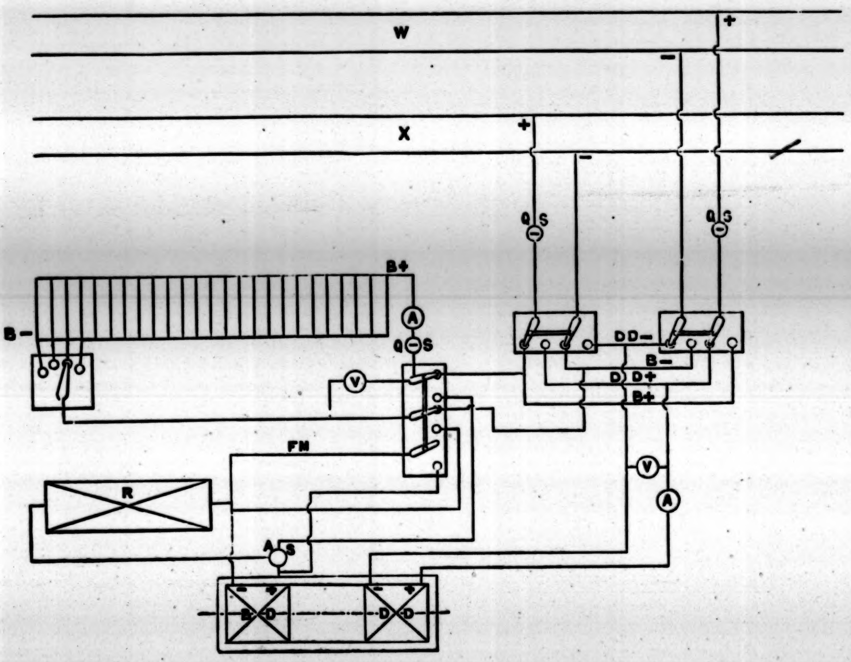

FIG. 1.

With this system the building to be lighted is wired with two complete circuits, as shown at W and X, either or both of which may be connected, by means of the double pole switches shown, with either the battery or the dynamo, D D; but in no way can connection be made between these two.

The *modus operandi* is as follows:—During charging hours the demand for light is, of course, a minimum, and the engine must have an excess of power above what is absorbed by the accumulator to supply this demand from the dynamo, D D. Both pairs of mains will under these circumstances be switched on to D D. When more light is required (by which time the accumulator will be charged) B D will be cut out of circuit altogether by the triple switch being turned into the position shown. Either the accumulator or D D may now be used for supplying the two mains, or in the event of the total requirement being beyond the capacity of either source of energy separately, one may be connected to each main circuit. In the diagram, D D is shown supplying current to W, and the battery to X.

Take the case of a private house, for instance:—During the day B D is charging the accumulator, and D D supplies any odd lights that may be required in cellars or other badly lighted corners, or on account of fog coming on. When charging is complete the accumulator alone will, on ordinary occasions, be sufficient for the evening's lighting, and the engine may be stopped and the attendant go home; but, when the house is full of guests, probably all the lights will be wanted—including arc-lights outside—and then the engine can be kept running.

To sum up:—As there are two lighting circuits and two dynamos, either of which can supply either circuit, nothing short of a complete break-down of the engine, or two short circuits, or two damaged dynamos, at the same time, can cause a total stoppage of lighting. If D D and the accumulator are both crippled together, B D can be temporarily employed to run a definite number of lamps. There is no waste of energy in counter E.M.F. cells or resistances. There is no danger of over-running lamps, as D D cannot do this, and the end cells of the accumulator are out of circuit at the conclusion of charging, and it is only as the lamps grow dim that these cells are at intervals switched in. When running lights and charging at the same time, the dead load of the latter will greatly conduce to steadiness of running; the turning of a lamp on or off causing a very small percentage alteration in the amount of power developed by the engine.

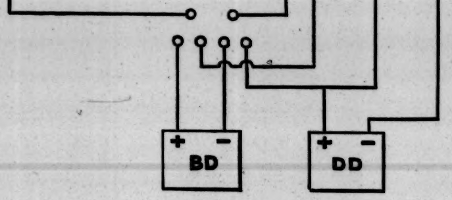

FIG. 2.

Instead of two independent circuits, the three-wire system may be used as shown in fig. 2. The accumulator switches will be coupled as in fig. 1; the main switches will be independent. B and D D may thus be put in connection with the whole system of lamps, either one at a time or the two in series.

W. S. Boult.

Liverpool, *December 4th*, 1889.

[illegible]

[illegible]

MANUFACTURERS [illegible]

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COTTON AND SILK [illegible]

LAU[illegible]

GO[illegible]

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[illegible] INTO for the SUPPLY, [illegible] and [illegible] of TELEGRAPH [illegible]

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